Chemical Engineering

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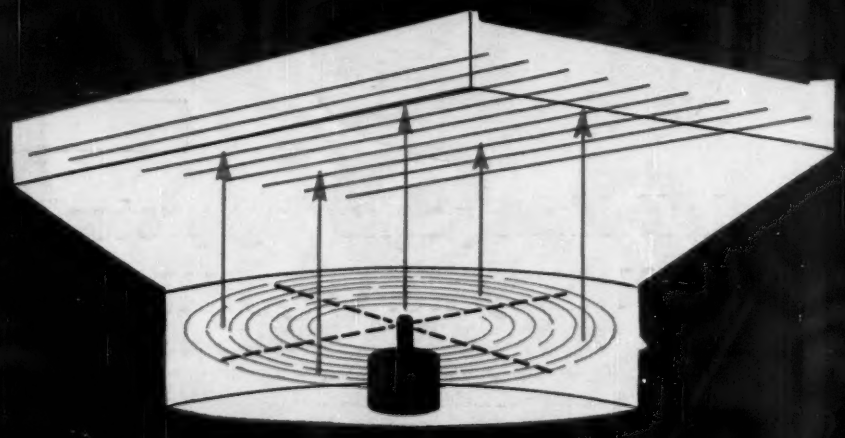

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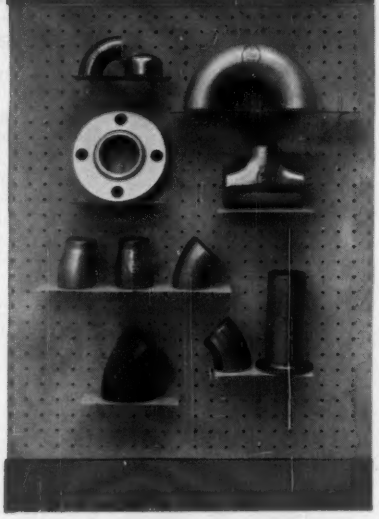

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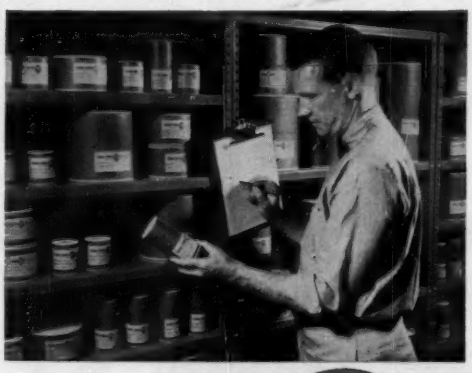

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BRIEFS

on information about sodium chlorate for those interested in chlorine dioxide ... a new drum for sulfides ... a grease that won't burn or corrode ... a booklet on trichlorethylene

Why you should know more about sodium chlorate

You've undoubtedly been hearing a lot about chlorine dioxide—how it is an unusually effective oxidizing agent—how it imparts no taste or odor to end products.

Not nearly as much has been said about chlorine dioxide's starting point—sodium chlorate. We think this ought to be corrected, since most everyone generates the chlorine dioxide right at the use point.

So it is we offer you a bulletin and technical data sheet.

The bulletin tells you all the accepted precautions used in handling and storing sodium chlorate. It tells how to unload a tank car and explains the operation and design of the valves used. It lists physical and chemical properties and illustrates them in a series of graphs and charts. It also offers methods of analysis.

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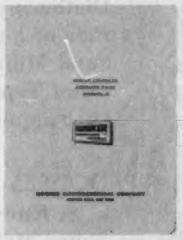
You can get both bulletin and data sheet simply by checking the coupon.



Get sulfides in new drum that empties faster, more safely

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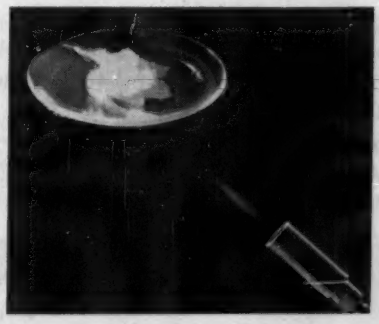

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- ☐ Bul. 99, Sodium Chlorate
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- ☐ Sodium Sulfide
- ☐ Fluorolubes
- ☐ Trichlorethylene booklet

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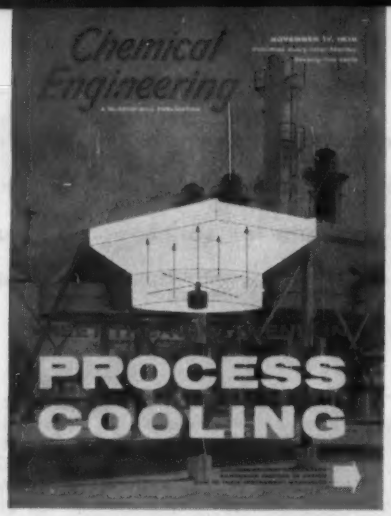

TWENTY-THIRD OF TWENTY-SIX ISSUES

23/26

Why use air instead of water?

Here's your introduction to the growing trend in heat-exchanger design. And meet all ten reasons why air is worth considering for your next process cooling job. See how fast these exchangers work, what kinds you can buy now. Cost figures, too, will help you make estimates for equipment and for operation. (p. 145)

Why help our high schools?

Why should your employer help public education? Why should he spend the funds of a private corporation this way? Here's a report of the accomplishments and value of the science-industry program. (p. 163)

More cost data on exchangers

Finned-tube prices, this time, join your growing collection of timely and practical cost-file figures. And see, too, how format has been changed for easier reading and even greater accuracy. (p. 166)

How to train instrument mechanics

Worried about a shortage of competent instrument mechanics? Take your cue from this tested plan. It's a do-it-yourself program that will put better-trained men on your operations and maintenance staffs. (p. 168)

Chemical

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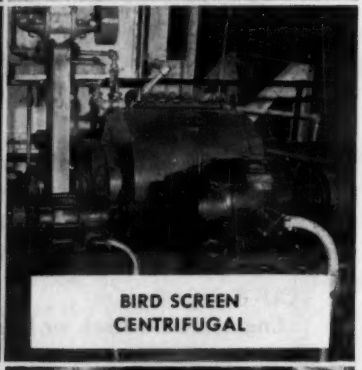

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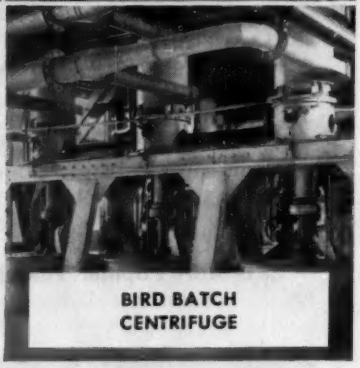

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Chemical Engineering

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Vaporizing Freon drives valve operator 88

Now operating in field tests, the Thermo-Drive actuator boasts simplicity and low operating costs, eliminates such costly items as air lines, compressors and motors.

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Petroleum and sulfur have long been tandem developments; more sulfur now comes from sweetening, but the search for oil brings elemental sulfur, too. This flowsheet shows how.

Take a look at air for process cooling 145

Here's the why and how of air-cooled heat exchangers. Our author shows you how to weigh the variables, how to make design-cost estimates and what exchangers you can buy.

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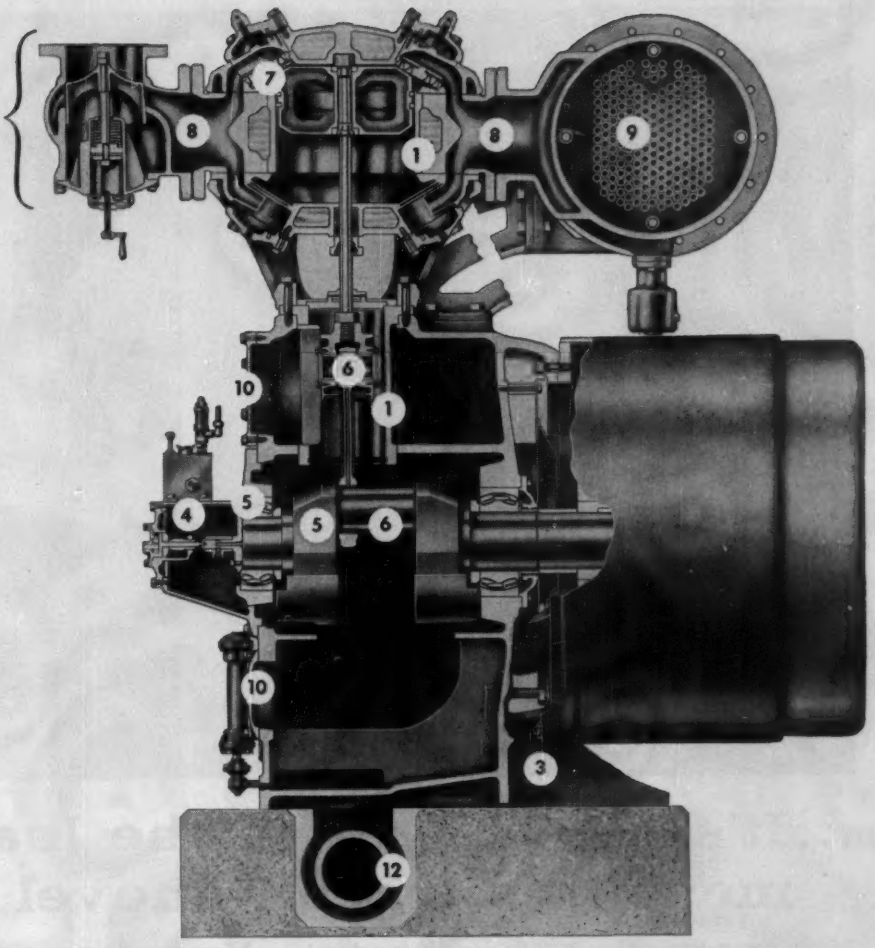

1. Honed, replaceable crosshead and cylinder liners of special alloy iron.
✓ One-piece, box type tinned cross heads—NO ADJUSTMENT NECESSARY.
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9. Dual copper tube intercoolers with cast iron shell for quiet operation, true counter flow design and built-in moisture separator
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✓ Water jacket cleanout openings.
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OPERATION: Precise balance and control requires less horsepower than any other system, delivers greater economy on CFM and KWH per HP.

Joy Compressors range from 1.93 to 6048 CFM with wide choice of Prime movers and drives. Write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

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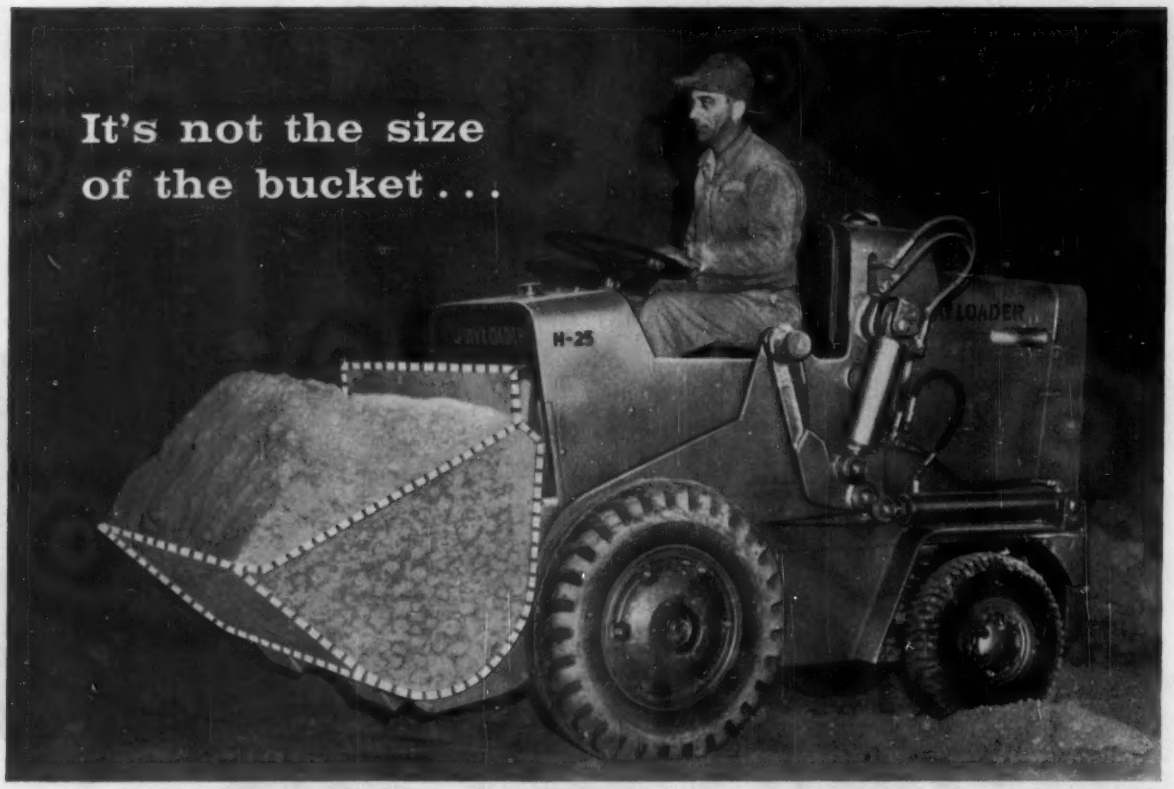

. . . It's the weight of the load that measures tractor-shovel capacity!

More pounds per load . . . Buying a tractor-shovel on the basis of bucket volume, without knowing the carry capacity IN POUNDS of the unit, is putting the cart before the horse. You may be getting too much bucket, or not enough, for handling *your* materials most efficiently.

Buying on the basis of lifting capacity can be equally misleading since any tractor-shovel can lift much more than it can carry. However, it is the number of pounds which can be moved safely at normal speeds, in relation to the weight of the material to be handled, which determines the proper bucket size.

The carry capacity of the new model H-25 "PAYLOADER" is 2,500 lbs. This is equal to 40% of the total machine weight and represents a new high in Capacity-to-Weight ratio for a unit of this class.

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FOR MATERIAL WEIGHING	BUCKET SIZE (S. A. E. RATED)	H-25 CARRY CAPACITY
up to 90# per cu. ft.	1 cu. yd.	2,500 lbs.
up to 105# per cu. ft.	⅞ cu. yd.	2,500 lbs.
up to 125# per cu. ft.	20 cu. ft.	2,500 lbs.
up to 155# per cu. ft.	16 cu. ft.	2,500 lbs.
up to 190# per cu. ft.	13 cu. ft.	2,500 lbs.

More loads per shift . . . The new H-25 "PAYLOADER" not only handles a big load for its size and weight, but has the speed, maneuverability and ease of operation which permits it to move more loads per shift. Features which make this extra productivity possible are full-reversing, power-shift transmission with two speeds forward and two reverse; torque-converter drive; power-steering; power-transfer differential which automatically shifts more torque to the wheel with the best traction, and fast, powerful hydraulic bucket control.

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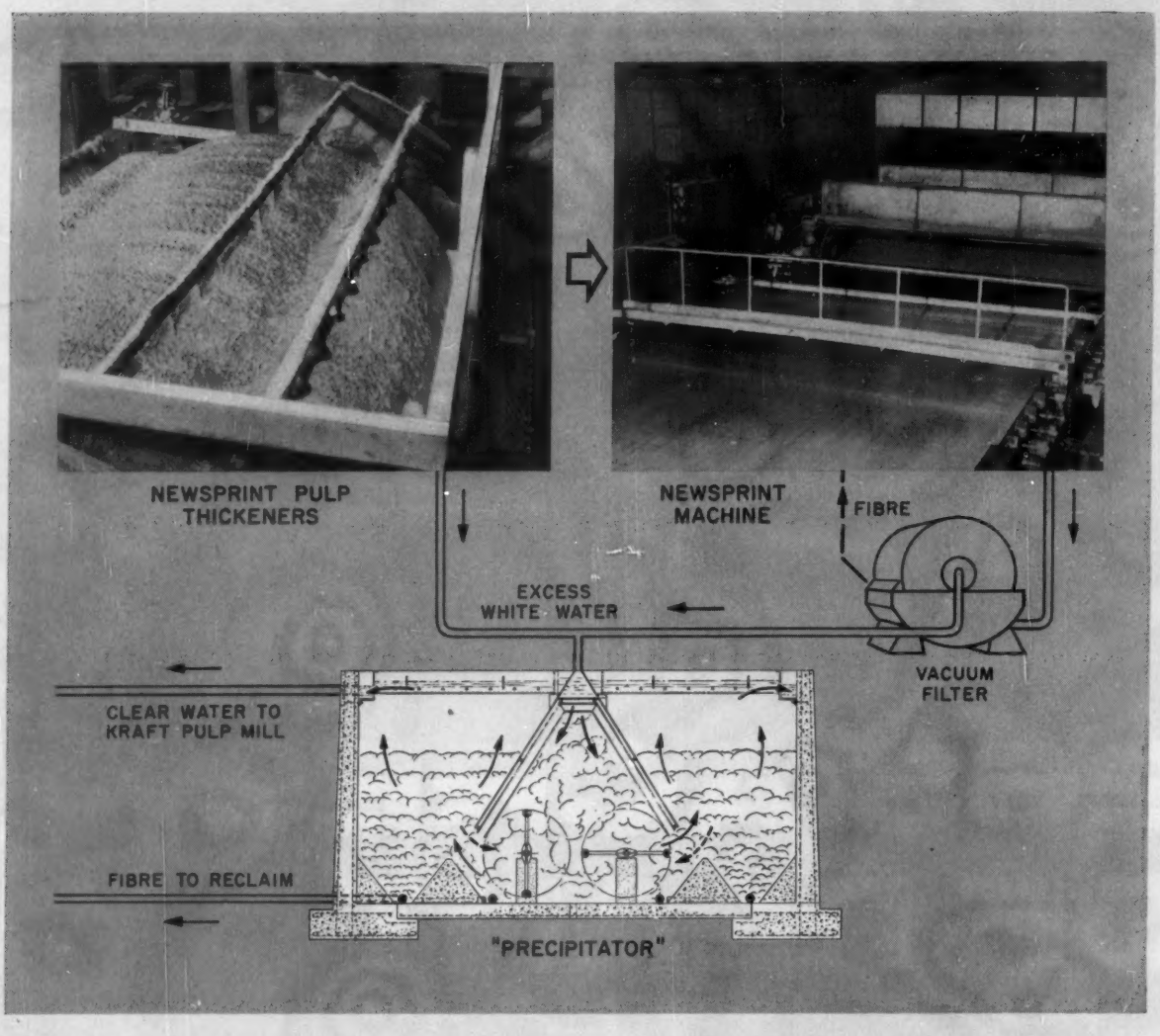

Paper mill recovers fibre, saves water, solves disposal problem with the "Precipitator"

Southland Paper Mills at Lufkin, Texas produce newsprint and kraft. They pump general fiber-bearing effluent from the groundwood mills and newsprint savalls to their Permutit *Precipitator* where suspended solids are removed. The clarified effluent is blended with fresh water and used as make-up in the kraft pulp mill. The precipitated fibre is reclaimed and returned to process as No. 1 quality groundwood for the newsprint machines.

The Precipitator offers two big advantages in this type of fibre recovery system:

1. *It is flexible in operation.* The *Precipitator's* principle of diminishing upflow velocity allows far wider latitude in flow rate. Flows as high as 50% over design capacity and as low as 80% below design capacity are often encountered without losing the blanket . . . as compared to constant-cross-section upflow units which depend on uniform flow rate and may lose their blankets with as little as 10% increase of flow over the design rate.

2. *It is expansible.* Units can be placed side to side and end to end. In some cases, drive shafts can be lengthened and a common drive used for a number of units. One mill, for example, started with 15000 gpm and has expanded to 27000 gpm with no loss of space between units.

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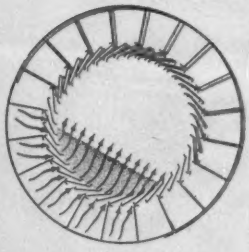
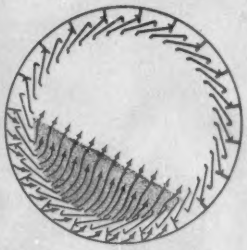


Section thru feed end

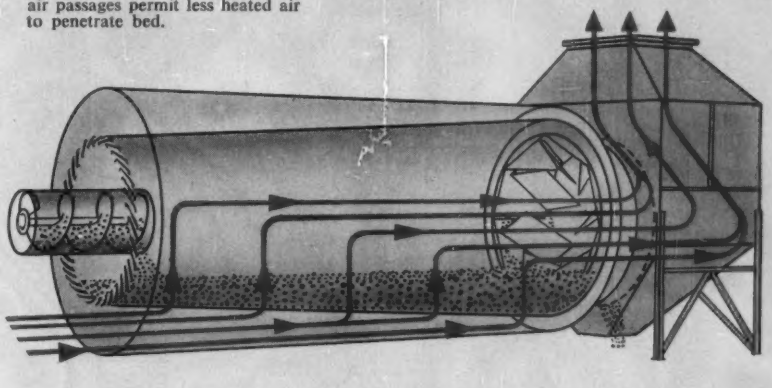


Section thru discharge end

1. NO OVERHEATING — Large volume of hot, dry air easily penetrates thin bed at feed end for maximum heat transfer where greatest evaporation can take place. At discharge end, smaller air passages permit less heated air to penetrate bed.

2. NO BREAKAGE — Material rolls gently over itself in a spiral path to the discharge end of the dryer, minimizing abrasive effects and degradation.

3. UNIFORM DRYING— Each face of every particle is reached many times by hot gases.

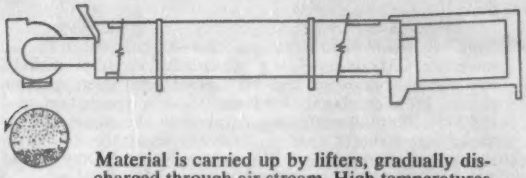


4. LOW MAINTENANCE — Mounted parallel on trunnion rollers, Roto-Louvre maintains its alignment.

5. LONG LIFE — Material rolls over itself—no abrasion of louvres. Hot gases hit metal only 25% of time.

6. COMPACT — Short retention time often saves up to 50% of floor space needed for other dryers.

Single-shell dryer for non-sensitive materials



Material is carried up by lifters, gradually discharged through air stream. High temperatures can be used for high-capacity drying of non-sensitive materials having uniform particle size. Although first cost is low, abrasive action is high as are space requirements.

For facts on the broad Link-Belt dryer line, see your nearby district office. And for data on the Roto-Louvre, write for Book 2511.

Only the Link-Belt Roto-Louvre offers all these advantages

ALTHOUGH Link-Belt builds several types of dryers, including a superior single-shell design, we recommend the Roto-Louvre wherever *sensitive* materials are to be processed. When there's a problem of overheating, breakage, variation of particle size or floor space—this precision dryer is the answer. We'll be glad to laboratory-test a sample of your material—a pound or a ton—work out drying, cooling or roasting procedures you can duplicate in your own plant.

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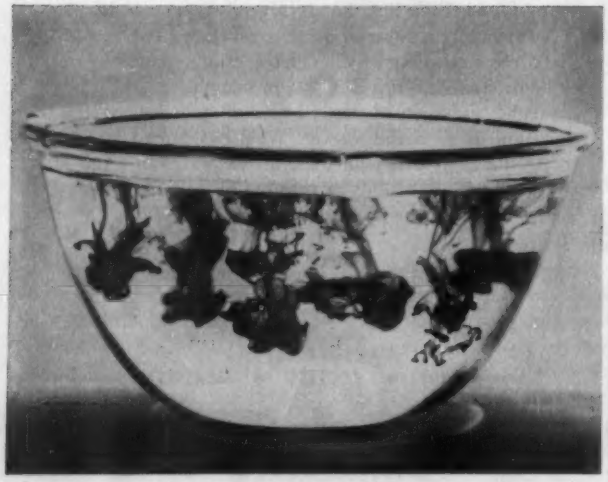
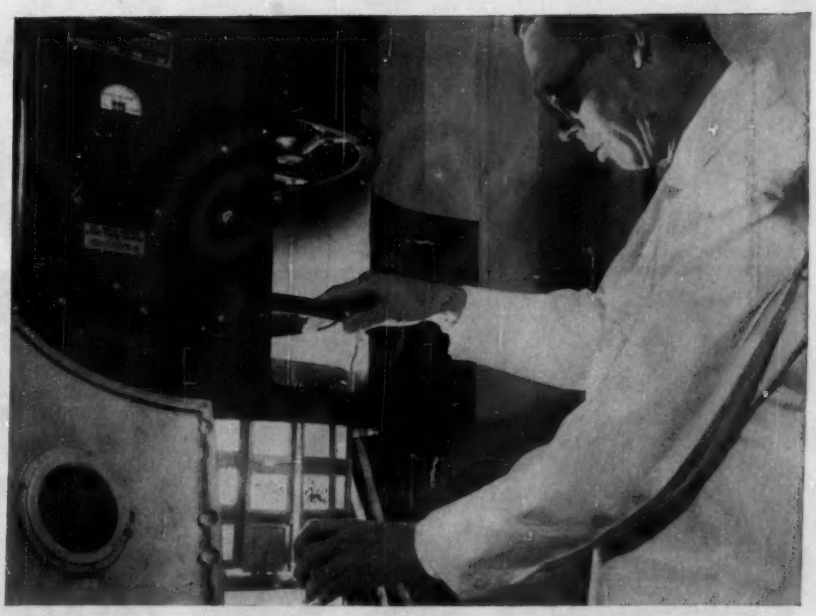
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World. 14,500

Life on the Chemical Newsfront

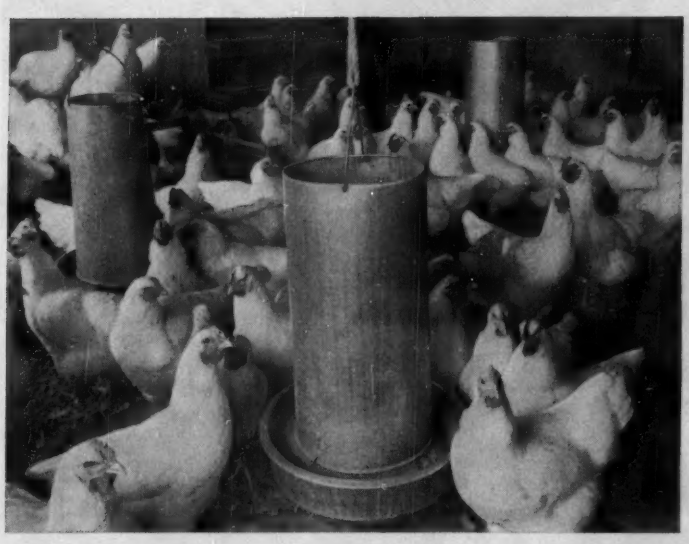
LEATHER COLORS OF UNUSUAL LIGHTFASTNESS are produced by CALCOFAST® *dyes*, which are also outstanding for levelness, clarity and transparency. Termed "metallized dyes" because of the introduction of a metal into the molecule, CALCOFAST dyes produce a full range of medium and pastel shades on leathers tanned with basic chrome sulfate or a combination of the chrome compound and synthetic tanning materials. Applied in the same manner as acid and direct dyes, CALCOFAST dyes are soluble in water and compatible with commonly used anionic and non-ionic wetting agents and water-soluble finishes.
(Organic Chemicals Division)



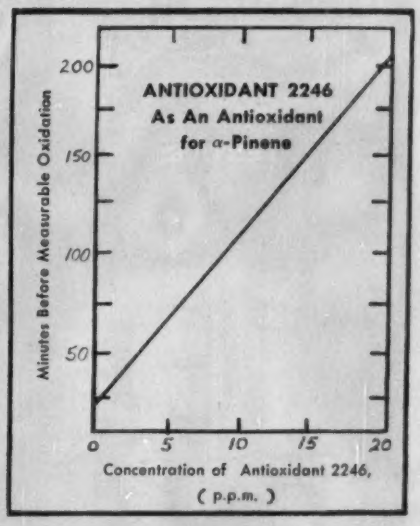
WHEN METALLIC IONS CLOUD YOUR PRODUCT, the trouble can often be cleared up with CYQUEST® 40 *sequestering agents*. Metal ions, present in only a few parts per million, can spoil color, cause turbidity, catalyze degradation reactions and otherwise affect product quality. CYQUEST 40 sequestering agent seeks out such di- and tri-valent metal ions and binds them securely as stable, soluble chelates. By isolating these ions, CYQUEST 40 eliminates problems in processing, shipping, storage and use of chemical products. **(Industrial Chemical Division)**



FADE-OMETER TESTS of polyvinyl chloride, as well as exposure tests conducted in Florida and Arizona, demonstrate the effectiveness of Cyanamid's CYASORB* *light absorbers*. Use of small percentages of CYASORB UV 24 in PVC, for example, prevents discoloration, embrittlement and other forms of degradation usually caused by outdoor exposure. Because CYASORB UV 24 absorbs strongly in the ultraviolet range and is unaffected by the absorption process, it gives long-lasting protection to UV-sensitive materials.
(Organic Chemicals Division)



NEW PROTECTION FOR LAYING HENS is provided by ARZENE* arsenosobenzene, the first coccidiostat to be accepted by the U. S. Food and Drug Administration for use with laying hens as well as broilers. ARZENE is being marketed by Cyanamid to feed manufacturers as a stable premix which is especially effective against the parasites that cause coccidiosis. Continuous feeding of ARZENE enables birds to develop immunity against troublesome species of coccidia. Extensive trial work shows the compound also stimulates growth and improves feed efficiency. **(Agricultural Division)**



GRAPH SHOWS EFFECTIVENESS of Cyanamid's ANTIOXIDANT 2246® as an oxidation inhibitor. Tests were conducted with 200-gram samples of α-pinene at 70° C with a continuous stream of oxygen bubbling through them. The induction period required before oxidation begins varies linearly with the concentration of antioxidant. Similar data indicate the usefulness of ANTIOXIDANT 2246 in other fats and oils, paraffin wax, petroleum products and as a polymerization inhibitor in chemical processes. Further data on chemical and physical properties and test results are available on request.
(Market Development Dept.)

*Trademark

CYANAMID

AMERICAN CYANAMID COMPANY
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

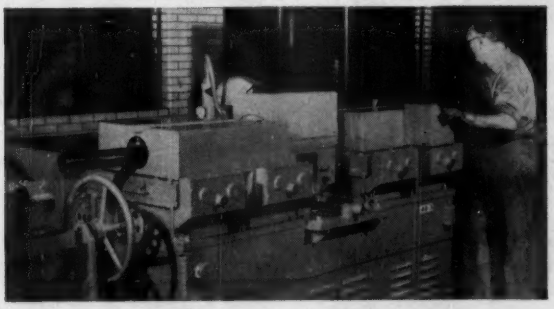
For further information on these and other chemicals, call, write or wire American Cyanamid Company

with lasting Economy
Stainless Steel Tubing and Pipe

Quality of your job is protected when quality materials are built in. Both you and your customers benefit from Republic's high quality-control standards when you install Republic ELECTRUNITE® Stainless Steel Tubing and Pipe.

Produced by Republic Steel—world's leading producer of alloy and stainless steels—in Republic mills to Republic's rigid specifications, ELECTRUNITE is welded by an exclusive process that unites the wall under pressure without additional foreign or extra metal. Tests prove the ELECTRUNITE weld is as strong, or stronger, than the original base metal.

Easy to install—ELECTRUNITE can be welded, threaded, or used with compression fittings. The ELECTRUNITE process assures uniformity of wall thickness, strength, ductility, concentricity, diameter, and other physical and mechanical properties for dependable, predictable workability.



And ELECTRUNITE quality offers end-users over-the-years economies. Smooth, free-flow lines resist corrosion and contamination. Product purity and quality are protected. Clean-up and maintenance time is substantially reduced.

Pipe sizes are available from ⅛" I.P.S. through 2" I.P.S. in A.S.A. schedule 40S; from ⅛" I.P.S. through 4" I.P.S. in schedule 10S; and from ½" I.P.S. through 4" I.P.S. in schedule 5S wall thickness. Positive identification is stenciled full length with type, heat number, and specification. You can easily identify it no matter where it's cut.

ELECTRUNITE Enduro® Stainless Tubing can be furnished with I.D. polished, O.D. polished or both I.D. and O.D. polished to meet any sanitary requirement.

For more information see your nearest Republic ELECTRUNITE Stainless Steel Tubing and Pipe distributor. Or, send for free brochure.

REPUBLIC FARROWTEST®

This is the best in non-destructive tests for tube irregularities. The tube moves through a group of test coils. The signal from these coils remains constant as long as the tube is uniform and defect-free. Only Republic offers this exclusive electronic "eddy current" type non-destructive test. Specify FARROW-TEST with your next order of ELECTRUNITE.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. C-5412
203 EAST 1315T STREET • CLEVELAND 8, OHIO

Please send me your free ELECTRUNITE Stainless Steel Tubing and Pipe brochure.

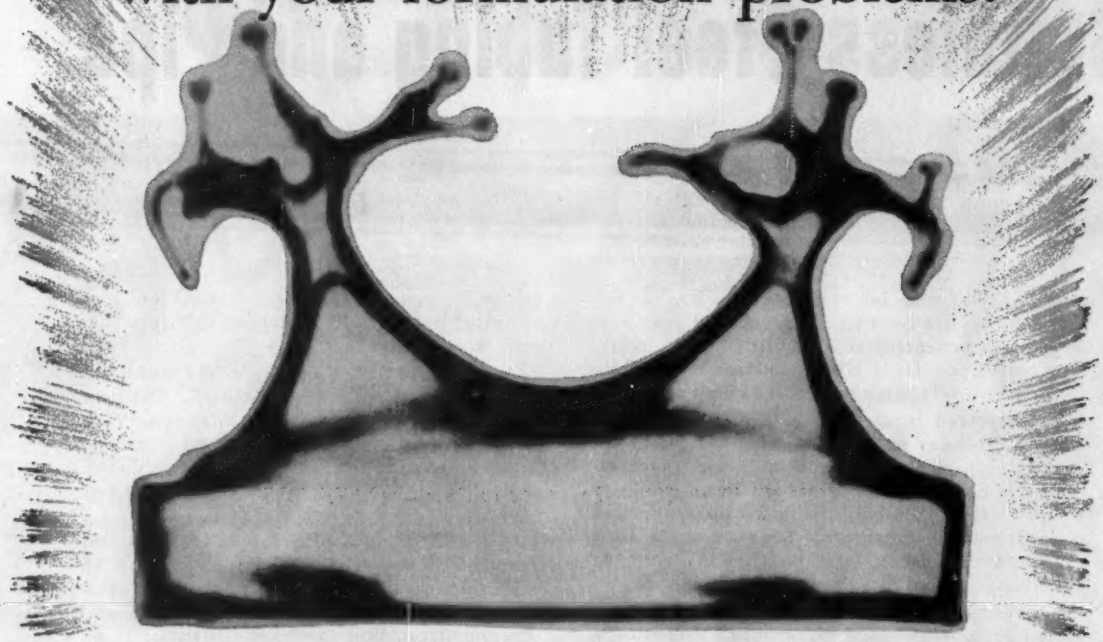
Name_____ Title_____

Firm_____

Address_____

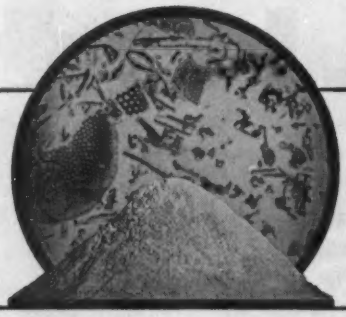
City_____ Zone____ State_____

What's this "CROWN" got to do with your formulation problems?



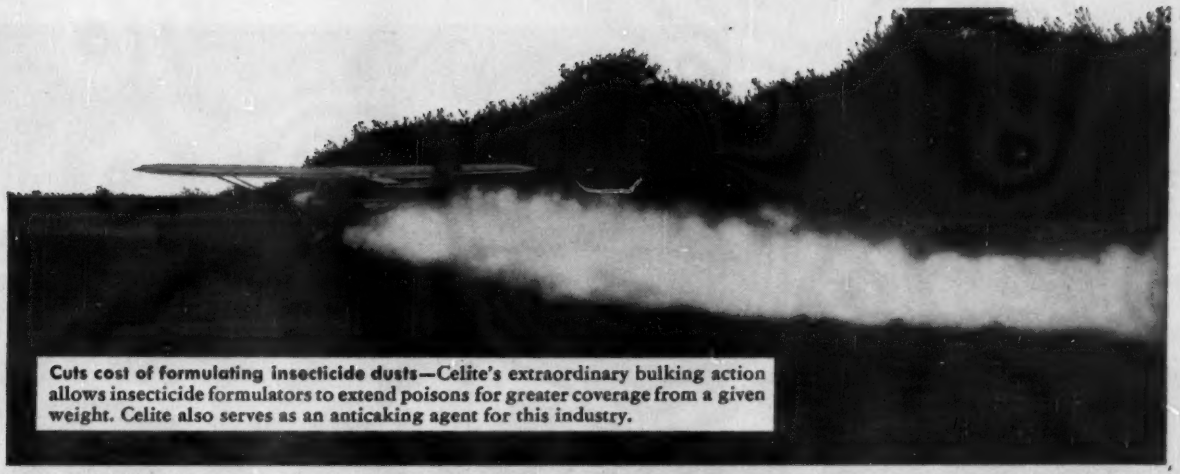
This is a particle of Celite diatomaceous earth. The genus is *Dicladia,* species is *Capreolus.* Loosely translated it means "two-sided branch." This particle is just one of hundreds of different intricate particles that together make Celite such an efficient mineral filler. When placed under a microscope *Dicladia Capreolus* becomes a rustic "crown."

It's a particle of CELITE with a cubic foot



The secret of diatomite's remarkable properties—The infinite variety of particle shapes and sizes gives Celite diatomite its exceptional performance characteristics in a wide range of process applications. Irregular shapes like the "crown" prevent packing down for high bulking action.

Johns-Manville CELITE



Cuts cost of formulating insecticide dusts—Celite's extraordinary bulking action allows insecticide formulators to extend poisons for greater coverage from a given weight. Celite also serves as an anticaking agent for this industry.

Controls package loss in cleansers—Cleansers and other powder products remain "fluffed up" after packaging when formulated with Celite. Celite also serves as an absorbent for detergents, wetting agents and odorants.

Adds needed bulk to paper—Because of its exceptionally low apparent density, Celite increases bulk in paper as much as 10% with a corresponding increase in machine speed. Celite is also used in paper mills to control pitch and improve brightness, opacity and ink receptivity.

—the inert mineral filler of bulk in every ten pounds

AS MUCH AS 10 TIMES greater bulking action than any other mineral filler. That's what you get when you formulate with Celite*. Composed of microscopic irregularly shaped particles of diatomite that won't pack down, Celite contains as much as 93% air space or voids in a given volume. And with its low cost per unit volume, Celite gives you far more bulk per dollar than other mineral fillers.

Many important filler applications are derived from Celite's unique properties. Its light porous mass provides great absorptive capacity, permitting preparation of high concentrate insecticides and other liquids in a dry, free-flowing powder form. The varishaped microscopic particles have large surface areas which serve to extend pigments in paint and papermaking. Other important uses include molded plastics, matches, concrete, acetylene tank fillers and adhesives.

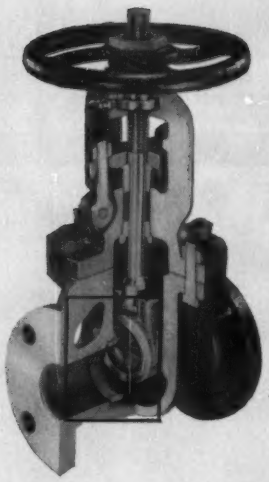
Produced from the world's purest commercially available diatomite deposit, Celite comes in a wide range of grades. Each grade is carefully controlled for complete uniformity.

Ask your local J-M Celite engineer to tell you how Celite can help solve your formulation problems. He's backed by Johns-Manville's extensive research facilities and years of practical diatomite experience. Call him today or write Johns-Manville, Box 14, New York 16, N. Y. In Canada, write Port Credit, Ontario.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

Industry's most versatile MINERAL FILLERS

JOHNS-MANVILLE JM PRODUCTS



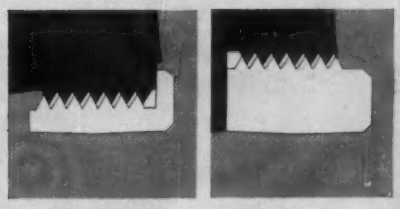
...and here's that same leakproof, streamlined seat ring– a steel valve feature, so good, we put it on our iron valves, too

OIC VALVES

BRONZE, IRON, FORGED AND CAST STEEL LUBRICATED PLUG VALVES

See how this *end*-seated ring fits into the valve body, out of the flow. It streamlines the body port, eliminates excessive pressure drop across the valve.

Here's how these rings reduce your maintenance problems . . .



Old-style, shoulder-seated ring cross section

OIC *end*-seated ring cross section

Old-style *shoulder*-type rings interrupt flow, cause turbulence. Since rings are seated in *tension*, they loosen and leak.

These OIC streamlined rings are *end*-seated in *compression* against the body. They can't loosen, even in continuous operation, so they won't leak.

3 OIC iron valve features that add to your maintenance savings

Yokes in all sizes permit replacement of the yoke nut when the valve is wide open, without interrupting flow.

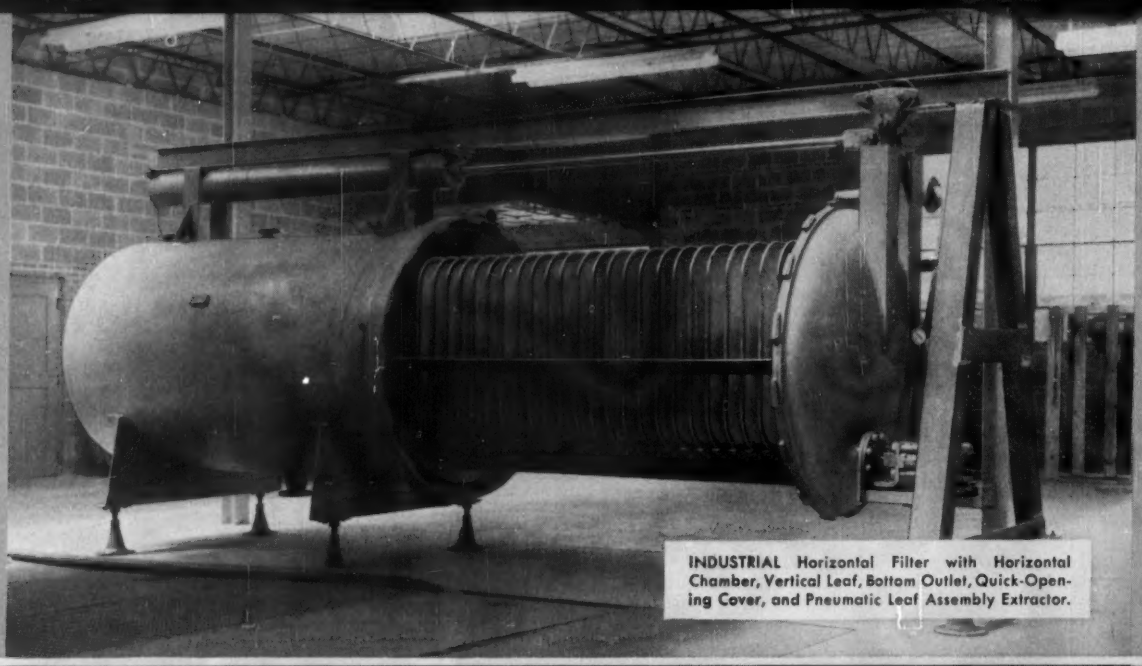
T-head stem-wedge connection prevents wedge from binding when closing the valve. Closing is easy, positive, least wearing to trim parts.

Threaded backseat bushing seals off upper bonnet of fully open valve. Makes repacking under pressure possible.

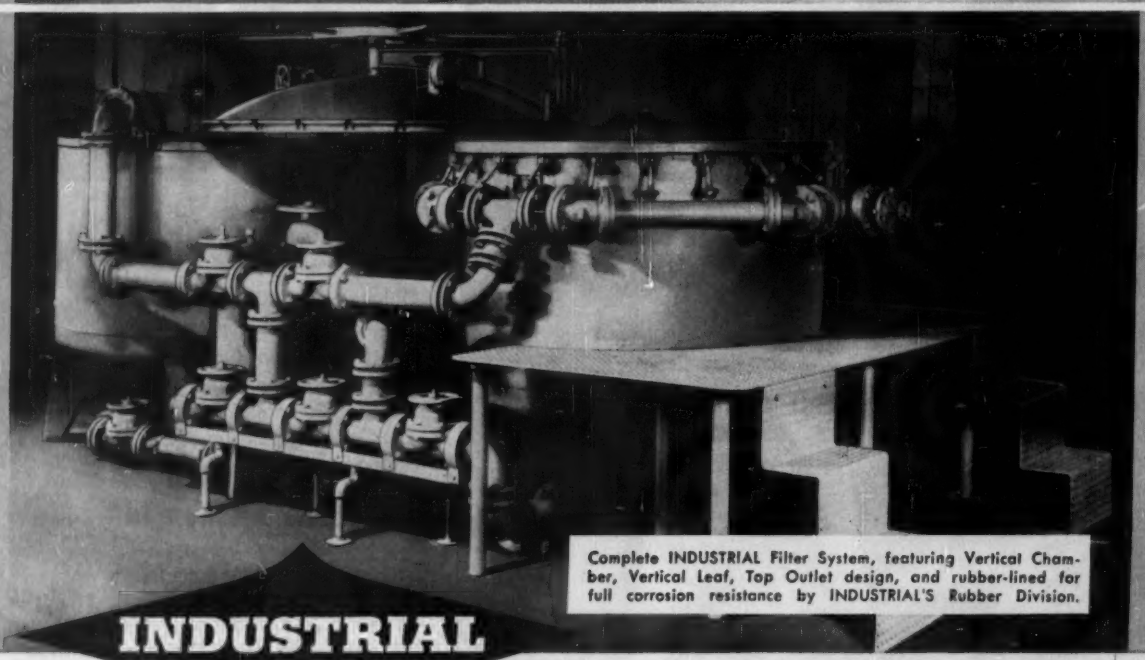
Choose for your service from 29 OIC iron valve numbers with 9 different trim and body metal variations. Order from your OIC Distributor or write for complete specification literature.

THE OHIO INJECTOR COMPANY

WADSWORTH, OHIO



INDUSTRIAL Horizontal Filter with Horizontal Chamber, Vertical Leaf, Bottom Outlet, Quick-Opening Cover, and Pneumatic Leaf Assembly Extractor.



Complete INDUSTRIAL Filter System, featuring Vertical Chamber, Vertical Leaf, Top Outlet design, and rubber-lined for full corrosion resistance by INDUSTRIAL'S Rubber Division.

INDUSTRIAL

Engineered Filtration Equipment and Techniques to improve product quality—cut processing costs

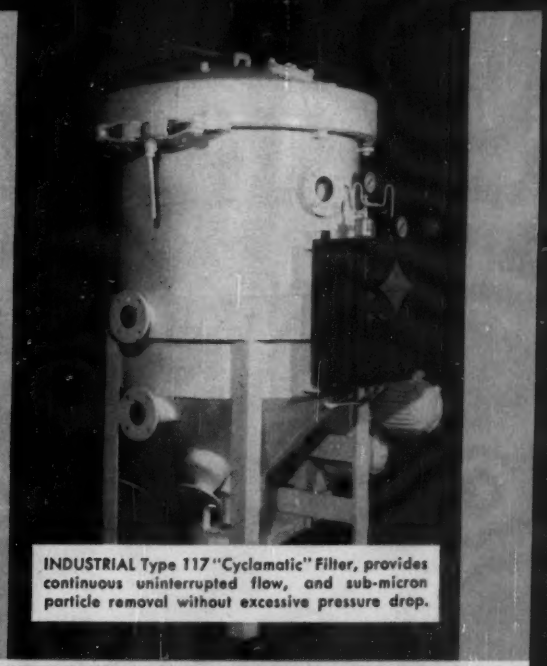
Your process is different in some ways from any other. That's why—for highest product quality, operating simplicity, and economy—you need a filtration system built specifically for you. An INDUSTRIAL *engineered* system is exactly that.

INDUSTRIAL is more than a builder of filtration equipment—it's a specialized engineering service that makes available to you over 25 years of filtration experience and techniques. Our engineers and chemists will work with you to develop a system which takes into consideration all the factors vital to your specific operation—type of slurry, filter design, cake recovery, cleaning, piping, auxiliary apparatus, and controls. At INDUSTRIAL'S Testing Center, there are complete facilities for pilot plant study of any system, ready to be put to work for you.

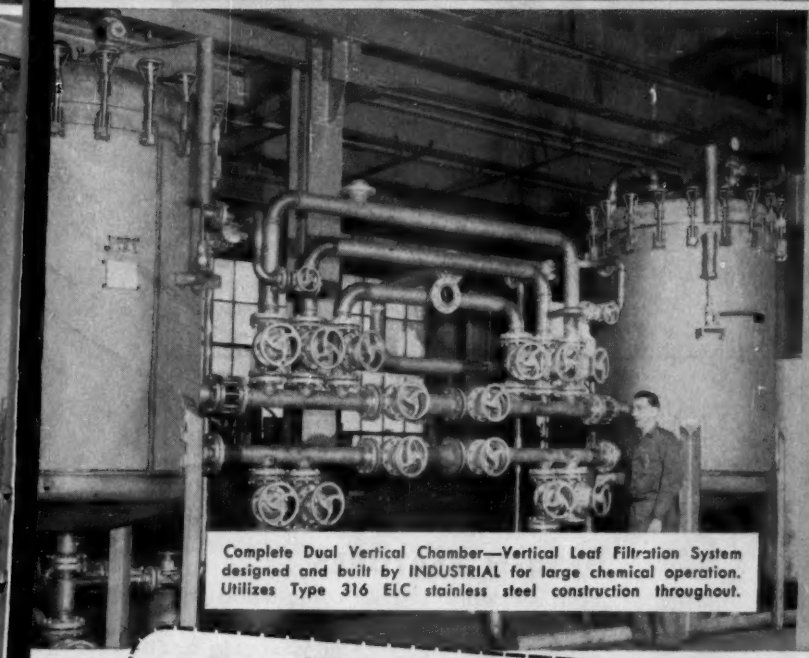
Remember, too, that INDUSTRIAL produces a full range of filter types and sizes—and can therefore recommend, without partiality, a filter most suitable for your needs. A wide variety of cost-saving optional features are also available. And all systems are adaptable to full or partial automation.

Call or write INDUSTRIAL to find out how properly-engineered filtration equipment and techniques can improve product quality and cut processing costs.

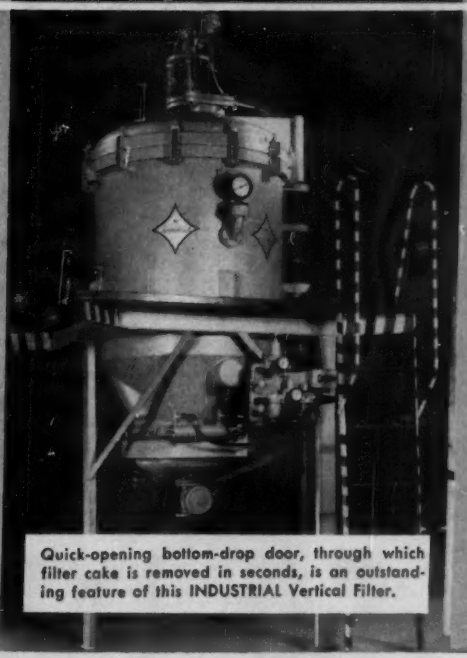
INDUSTRIAL Type III Vertical Filter in petrochemical service. Features Vertical Chamber, with Vertical Leaves and Bottom Outlet.



INDUSTRIAL Type 117 "Cyclamatic" Filter, provides continuous uninterrupted flow, and sub-micron particle removal without excessive pressure drop.

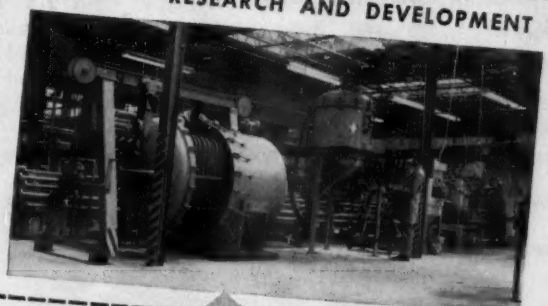


Complete Dual Vertical Chamber—Vertical Leaf Filtration System designed and built by INDUSTRIAL for large chemical operation. Utilizes Type 316 ELC stainless steel construction throughout.

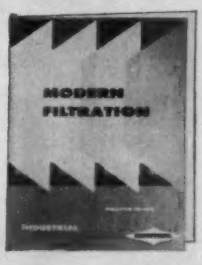


Quick-opening bottom-drop door, through which filter cake is removed in seconds, is an outstanding feature of this INDUSTRIAL Vertical Filter.

RESEARCH AND DEVELOPMENT TESTING CENTER



Here, your process conditions can be duplicated and studied —to help you select the most suitable filtration system, without disturbing your production. This Center includes all types of pressure filters and auxiliary equipment—all interconnected by an ingenious valve and piping system. Comparative data on variations is obtained in *minutes*, instead of days of costly experimentation in your own plant.



***Write** today for descriptive literature and recommendations on INDUSTRIAL equipment to meet your specific requirements.*

C358

INDUSTRIAL

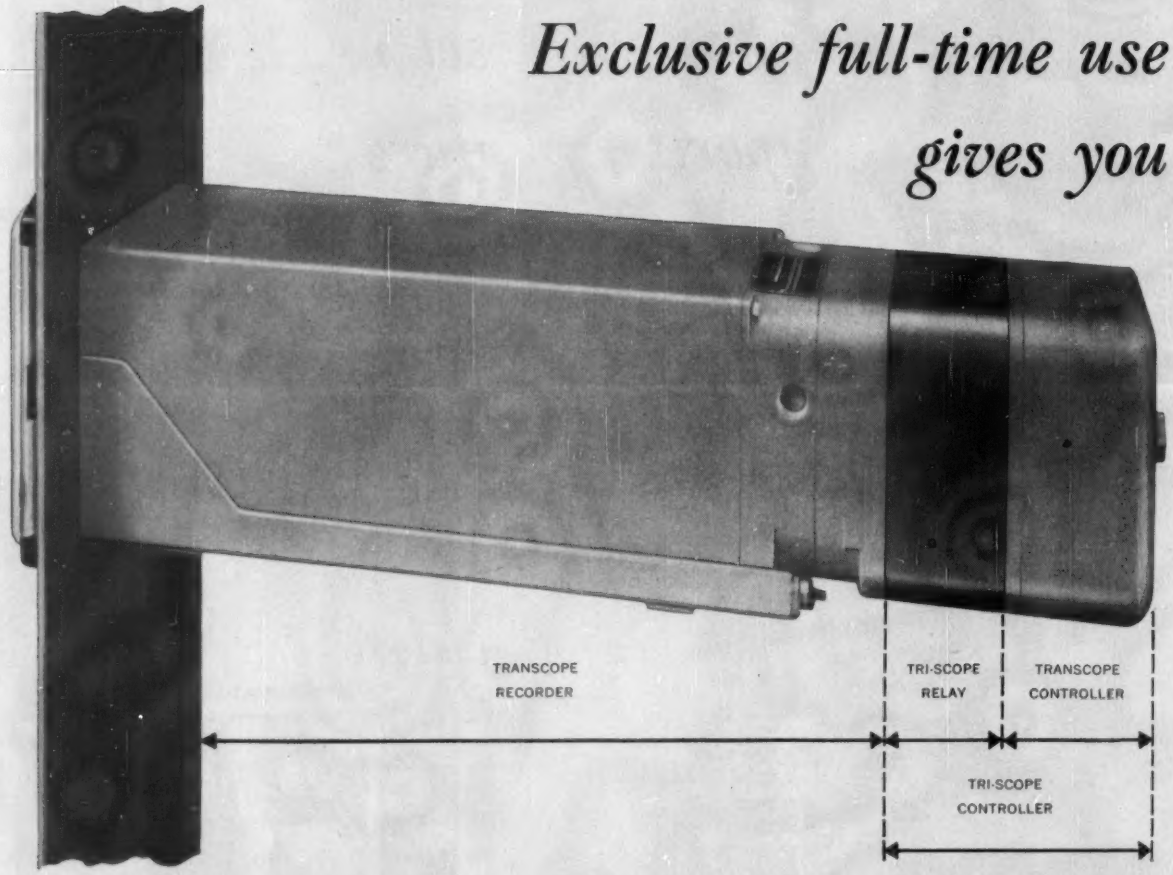
INDUSTRIAL FILTER & PUMP MFG. CO.

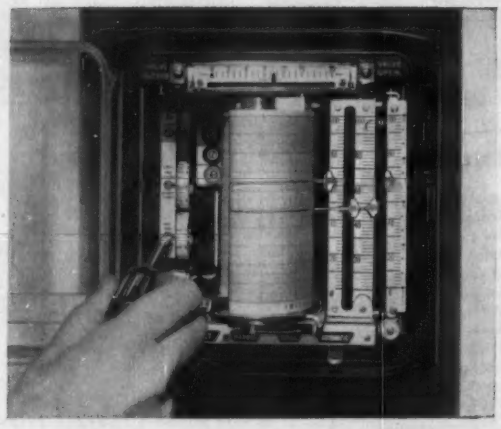
5918 Ogden Avenue, Chicago 50, Illinois

PRESSURE FILTERS ◆ ION EXCHANGE EQUIPMENT ◆ WASTE-TREATING EQUIPMENT

NEW TAYLOR

Exclusive full-time use gives you





90J SERIES
TRANSCOPE RECORDER

DESIGN FEATURES

- *Plug-in construction.*
- *Response adjustments made from front or back of panel.*
- *Mounts neatly between TRANSCOPE Recorder manifold and TRANSCOPE Controller.*
- *Can be added whenever process changes require it.*
- *Either field or panel mounting available.*
- *Uses standard TRANSCOPE parts.*

*Trade-Mark

Taylor Instruments

TRI-SCOPE* CONTROLLER

of derivative-ahead-of-reset response†
these three important features

1 – Start up without overpeaking

2 – Recovery from large load changes without overpeaking

3 – Superior control following normal load changes

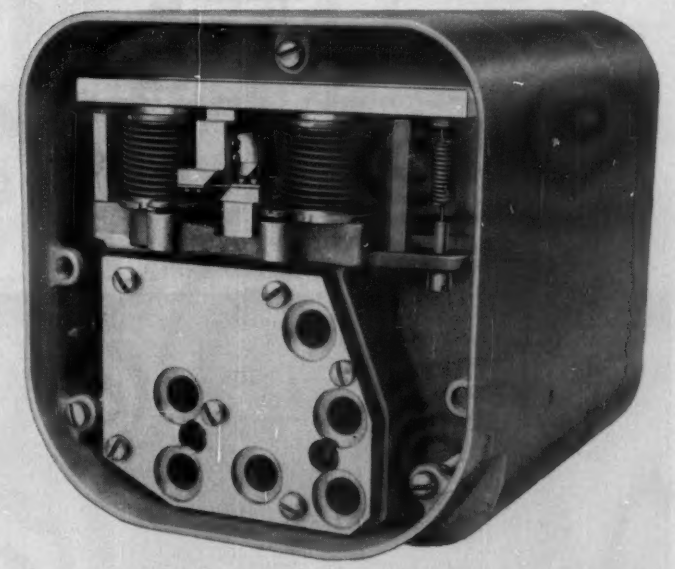
†Pioneered by Taylor in the TRI-ACT Controller*

HERE is the perfect solution to your problems of overpeaking on start-up and large load changes—inherent weaknesses of proportional-plus-reset controllers. It is equally effective *at all times* whether variable is approaching control point from above or below—on start-up, or following major process disturbances or changes in set point.

The TRI-SCOPE Controller consists of a proportional-plus-PRE-ACT*-response relay, called the TRI-SCOPE relay, and a proportional-plus-reset TRANSCOPE* Controller. This combination provides controller characteristics similar to that of the TRI-ACT Controller, making possible the three major benefits listed above.

This unique new controller has been time-proven on one of the toughest possible reactor applications. For full information see your Taylor Field Engineer, or write for Bulletin No. 98332. Taylor Instrument Companies, Rochester, N. Y., or Toronto, Ont.

For Vision . . . Ingenuity . . . Dependability in solving your process control problems.

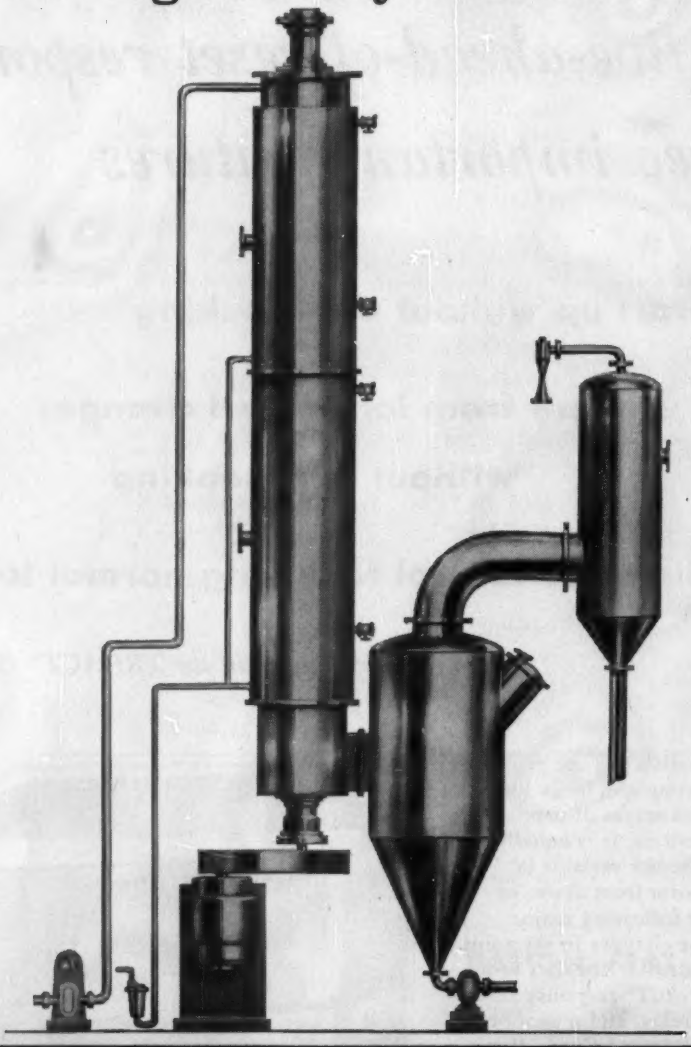


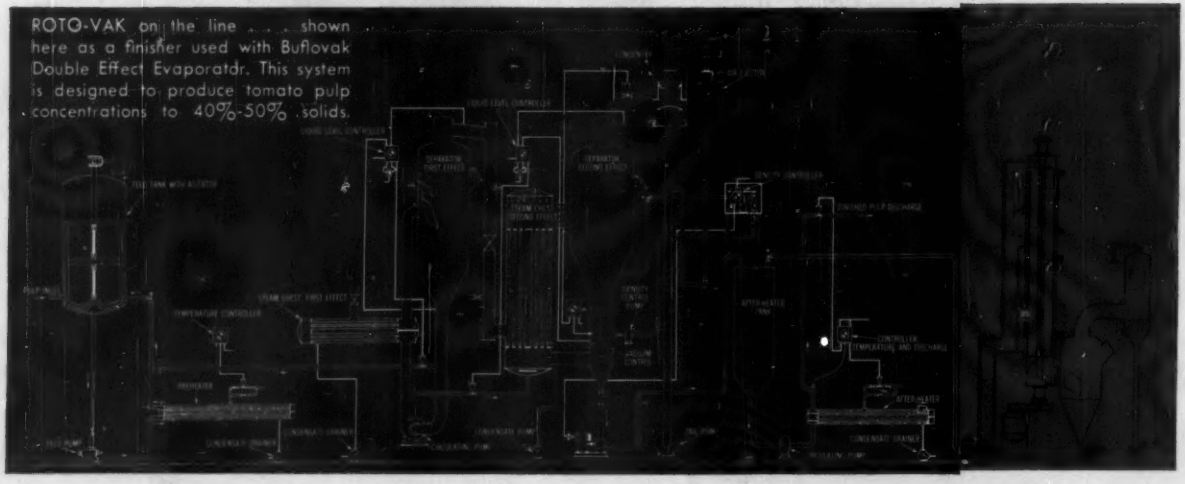
NEW 414RF TRI-SCOPE CONTROLLER

MEAN ACCURACY FIRST

New Buflovak

...provides high density heat transfer...helps





ROTO-VAK on the line . . . shown here as a finisher used with Buflovak Double Effect Evaporatdr. This system is designed to produce tomato pulp concentrations to 40%-50% solids.

Agitated Film ROTO-VAK

upgrade product quality . . . cuts production costs

Whatever your product—viscous, foamy or extremely heat-sensitive—the new Buflovak Agitated Film ROTO-VAK will produce a high quality product . . . and build your processing profits.

A product of Buflovak's extensive background in evaporation, this ROTO-VAK permits *high density* concentration of a whole range of new materials. Turbulent, thin film action provides superior heat transfer rates with shortened controlled contact time.

Temperatures formerly regarded as critical for many heat-sensitive products are now practical. For more details of this new advance in profitable processing, write for the new ROTO-VAK Bulletin No. 383.

Handles any fluid material. Any material which can be pumped can be processed effectively in Buflovak's new ROTO-VAK.

External Vapor Separator provides high efficiency, centrifugal separation. Vapor and product are separated independently from the heating surface. True down-flow design eliminates reflux of product.

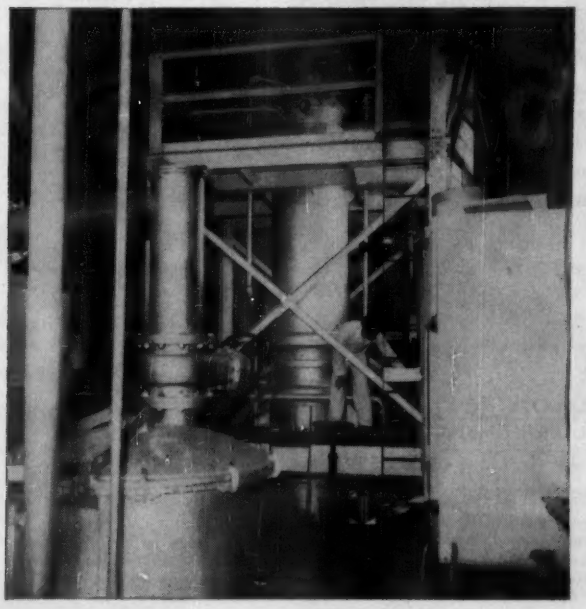
Main Drive at floor level affords easy access for maintenance. Located off the center of the rotor, the entire rotor assembly is easily removed when required.

External Bearings use well designed mechanical seals or stuffing boxes to eliminate product contamination. Only the rotor assembly contacts the product.

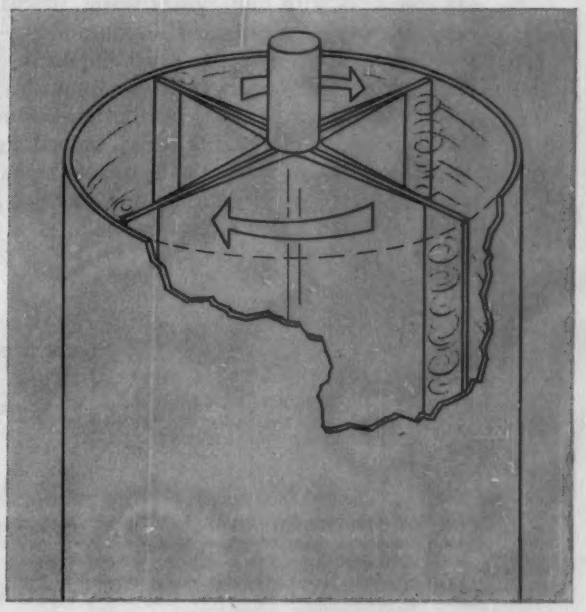
BLAW-KNOX

BLAW-KNOX COMPANY
Buflovak Equipment Division
1551 Fillmore Avenue, Buffalo 11, New York

ROTO-VAK produces tomato paste at 40% to 50% solids. The concentrated product retains its original qualities, is immediately ready for canning. An additional sterilization process is eliminated.

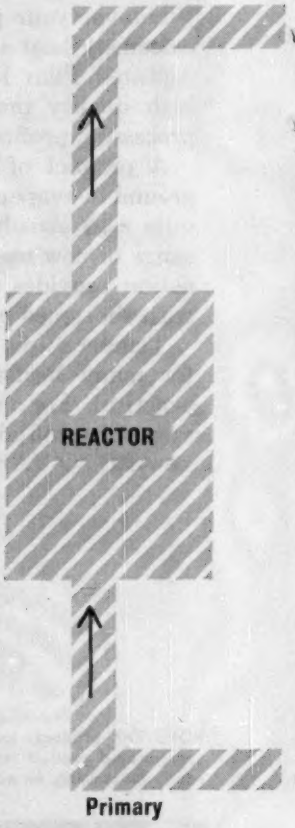


The spinning rotor agitates the down-flowing, thin-film of liquid into a violent turbulent action. Burn-on, and encrustation due to over-heating are eliminated.



SPECIFICATION: Alcoa Aluminum

CHARACTERISTICS: low cost • minimum metal pick-up • short half life • special resistance to CO_2 • no color imparted • nontoxic • contributes no iron or copper contamination



High purity water itself represents an appreciable investment. Protection of that investment requires a special combination of characteristics in the metal used to contain high purity water. Aluminum provides those properties at a cost far lower than that of other metals which might be used. That's why more and more ALCOA® Aluminum is being specified today for handling high purity water in such varied applications as these: reactor cooling systems in nuclear power plants . . . condensate handling in both nuclear and orthodox power generation systems . . . pharmaceutical manufacturing . . . television picture tube manufacturing . . . and a variety of laboratory systems where high purity water must be stored or circulated.

The outstanding corrosion resistance of aluminum insures minimum metal pick-up—important to maintaining water purity at the highest possible level. Aluminum's special resistance to CO_2 makes it ideal for storing or handling boiler condensate. It imparts no color to the water it contains. It is nontoxic. And aluminum's short half-life makes it an ideal material for atomic reactor applications (see flow chart).

In addition to all this, aluminum combines light weight with great strength in alloys. It has excellent thermal conductivity . . . is nonmagnetic and nonsparking . . . is highly workable and lends itself to a variety of welding or brazing techniques for sound, easy fabrication. And, again, aluminum provides all these assets at the lowest cost.

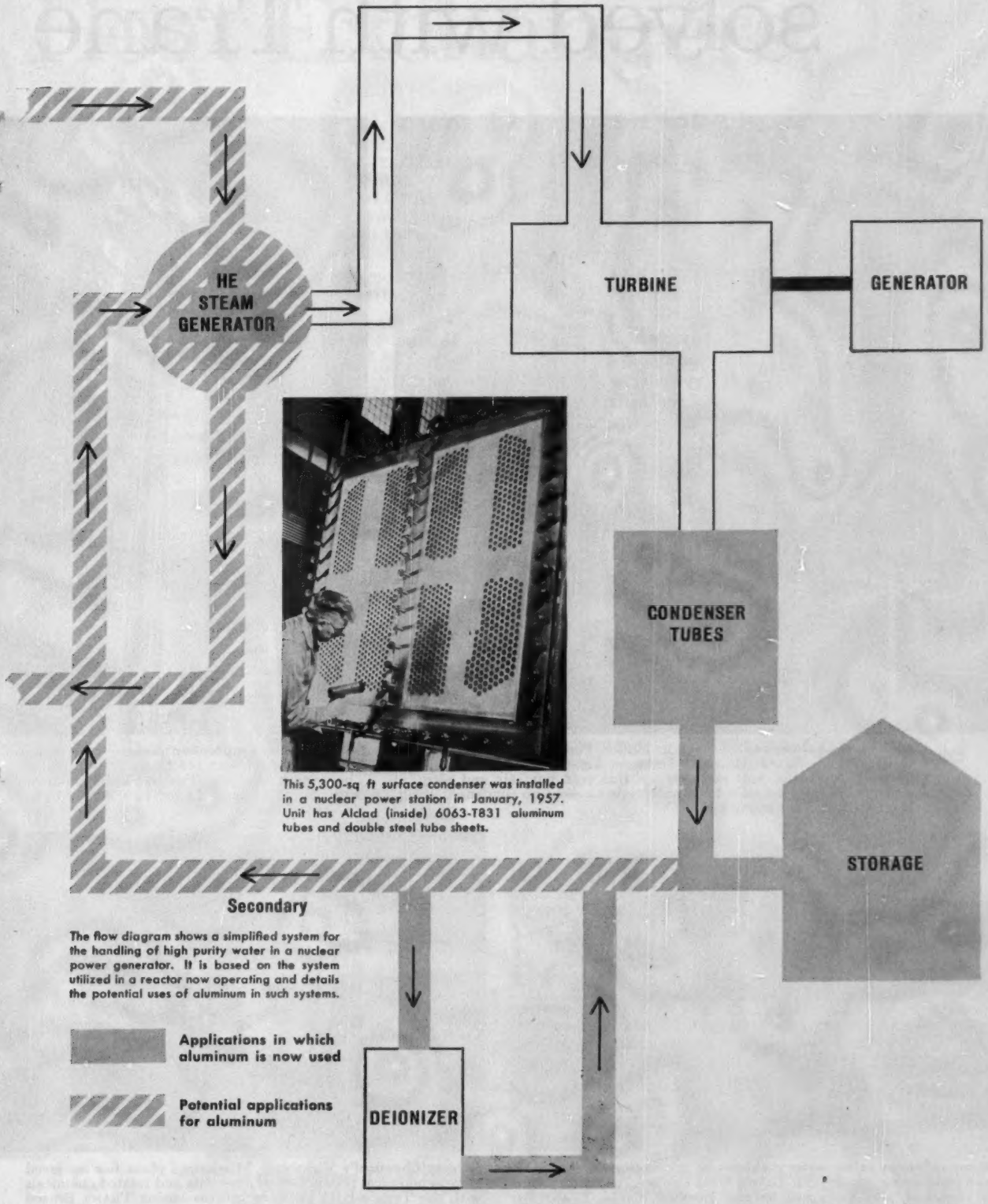
If you work with high purity water, it will pay you to discover more about the ways you can use aluminum to make your systems work best, most economically. ALCOA's development engineers have had many years' experience working with aluminum in nearly every type of high purity water storage and distribution system. Their experience is at your disposal. Simply write Alcoa, describing the requirements of your system, in order to receive all available technical data and performance information. Address ALUMINUM COMPANY OF AMERICA, 903-L Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA THEATRE
Fine Entertainment
ALTERNATE MONDAY EVENINGS

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

SEND FOR THIS FREE LITERATURE. Alcoa will be happy to send you this comprehensive set of literature related to the use of aluminum in high purity water systems. Included are several papers from Conferences of the National Association of Corrosion Engineers, a five-year service report on an aluminum condenser tube installation and other technical data. You can obtain this data promptly by writing Alcoa at the address given above.

for high purity water systems



This 5,300-sq ft surface condenser was installed in a nuclear power station in January, 1957. Unit has Alclad (inside) 6063-T831 aluminum tubes and double steel tube sheets.

The flow diagram shows a simplified system for the handling of high purity water in a nuclear power generator. It is based on the system utilized in a reactor now operating and details the potential uses of aluminum in such systems.

Applications in which aluminum is now used

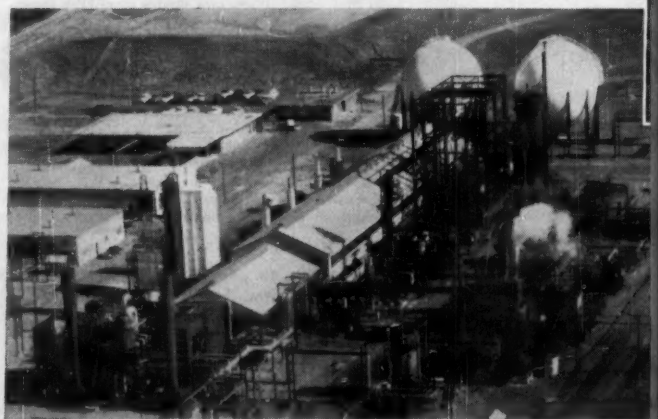
Potential applications for aluminum

5 process heat solved with Trane

Air Reduction Company designed its Butler, Pennsylvania liquid oxygen plant around TRANE Brazed Aluminum Heat Exchangers, *obtaining efficient, economical heat exchange.* In this cold box, air and nitrogen streams are reversed on a 10-minute cycle to clean up condensed water, ice, CO^2 and other impurities.

Foster Wheeler Corporation designed this synthetic nitrogen plant for Deere & Company. They report that the TRANE Heat Exchange equipment *has operated four years without trouble of any kind.*

Many refineries solve water problems by *air-cooling* liquids, gases and condensing vapors with TRANE Fluid Coolers. Also widely used in chemical, petroleum and natural gasoline plants, TRANE Air Coolers cut real estate costs and maintenance expense. And while they cost no more than other types of cooling equipment, they have a far greater life expectancy.



Spencer Chemical's Vicksburg, Mississippi plant has achieved more economical production of ammonia and related chemicals with the Texaco-HRI methane process—using TRANE Brazed Aluminum Heat Exchangers. Temperature approaches as close as 5° F *reduce power costs for refrigeration;* compact design cuts space and construction costs.

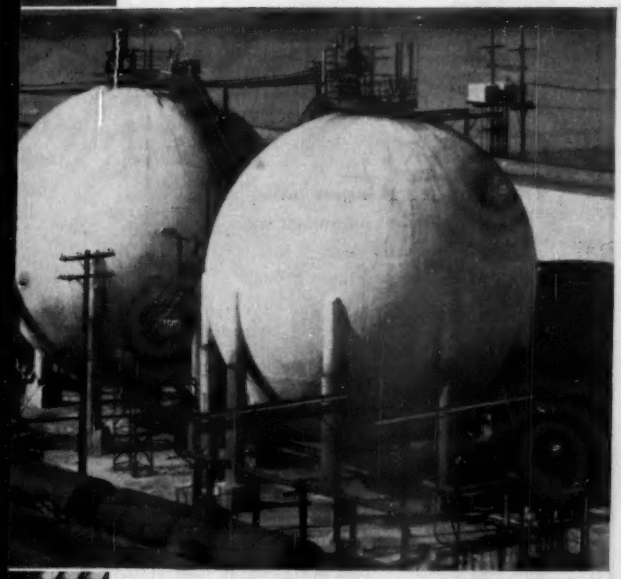
transfer problems Heat Exchangers

Every year, more and more plants are relying on TRANE Heat Transfer equipment for a wide variety of process applications. These plants report that TRANE Heat Transfer equipment helps them in five important ways:

- **Reduced refrigeration costs**
- **Close temperature approaches**
- **Efficient, economical heat exchange**
- **Trouble-free operation**
- **Elimination of water problems (with TRANE Fluid Coolers)**

TRANE Brazed Aluminum Heat Exchange equipment is lightweight, compact—packs 450 sq. ft. of heat exchange surface into 1 cubic foot. Its performance characteristics give you temperature approaches as close as 5° F. Rugged and dependable, it withstands operating pressures as high as 600 psig. And you cut space and construction costs, too, because a typical cold box with TRANE Brazed Aluminum Exchangers requires only *half as much space* as one with conventional heat transfer equipment!

If you have a process heat transfer problem, turn to TRANE. Over thirty years of varied heat transfer experience is at your service! Ask your TRANE Sales Office for information, or write directly to TRANE, La Crosse, Wisconsin.



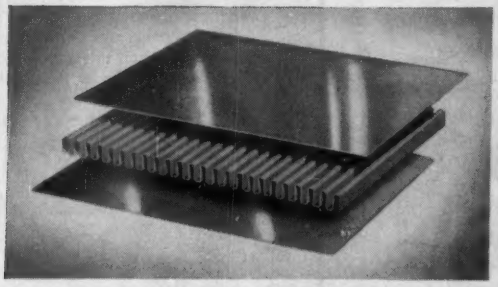
For any air condition, turn to

TRANE

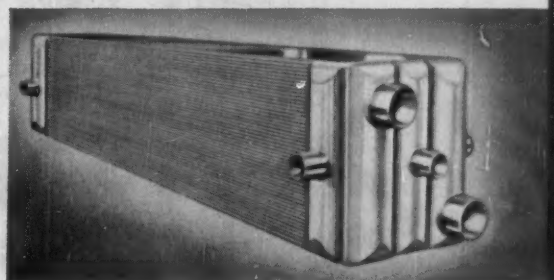
MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. DIV., SCRANTON, PA. • CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN. • TRANE COMPANY OF CANADA, LIMITED, TORONTO • 97 U. S. AND 19 CANADIAN OFFICES

The Atlantic Refining Company reports *temperature approaches of 5° F* plus 99.99% pure anhydrous ammonia in their Philadelphia plant—using fifty TRANE Brazed Aluminum Heat Exchangers.



Lightweight, compact TRANE Brazed Aluminum consists of corrugated aluminum sheets brazed together to form a stack of layers which form individual passages for the flow of fluids or gasses. Provides up to *nine times* the surface per square foot of shell-and-tube exchangers!



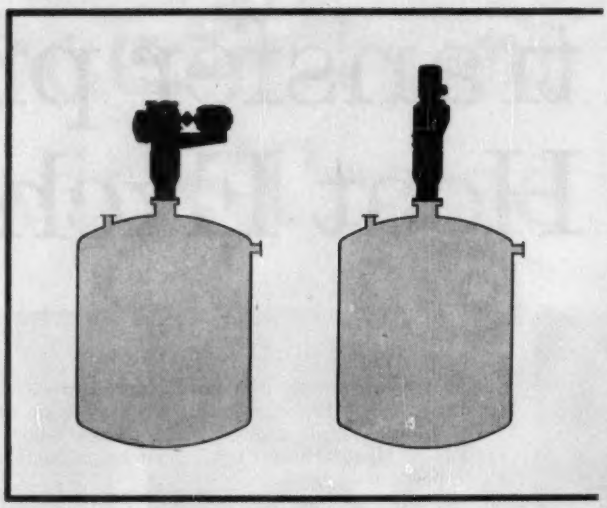
Headered for 5-stream operation, this TRANE Brazed Aluminum Heat Exchanger can handle as many as five fluids simultaneously. Units are available for either cross-flow or counter-flow operation. Surface can be fabricated in a wide variety of shapes and sizes to meet all types of requirements.

Q. If headroom is no problem, do vertical motor mixer drives have any advantages over horizontal motor units?

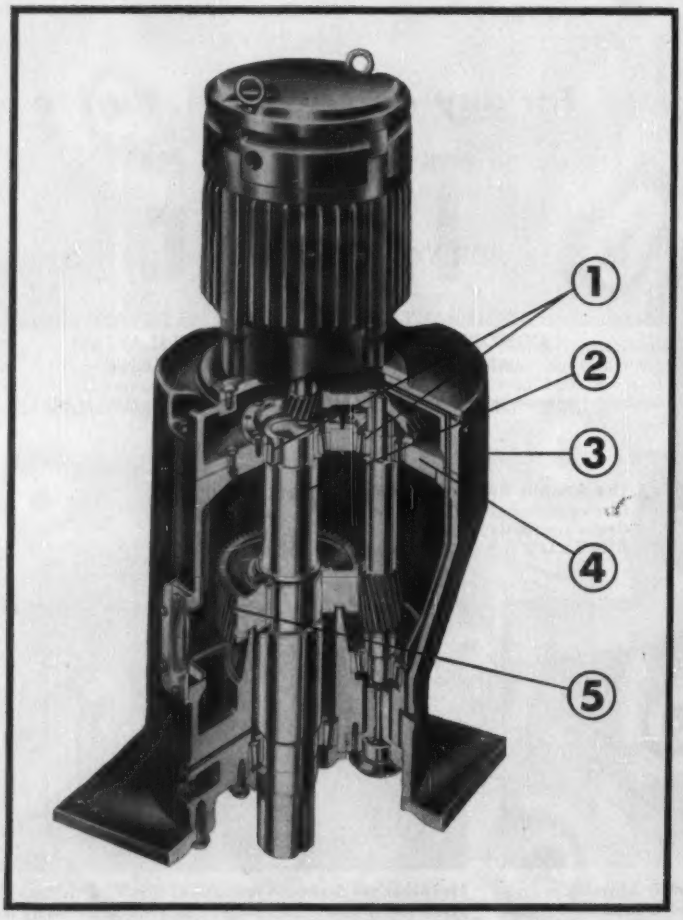
A. Philadelphia horizontal motor "3800 Series" and vertical motor "MV Series" both have the same high quality construction. From the standpoint of performance, drive efficiency and life expectancy, they are equal. However, each type has certain inherent advantages.

"3800 Series" units have an advantage in operating and mounting flexibility to meet changing process requirements. Change-gear sets are easier to install. Motors are somewhat easier to replace and horizontal drives can more readily utilize special motors such as variable speed types. Headroom requirements for the "3800 Series" are minimum for maximum bearing span. On the other hand, horizontal motor drives occupy more room immediately above the tank top and stresses imposed upon mounting nozzles by the overhung motors can require extra drive support . . . especially in the larger sizes.

"MV Series" vertical motor units have an advantage in that they occupy much less space at tank top, making it easier to install process piping. Better access to the tank is provided. Supporting difficulties are minimized because vertical drives are better balanced. While vertical motor drives are less flexible for a quick change of motors and output shaft speed, their greater inherent design simplicity makes them a more economical offering. They will usually be a sound choice when adequate headroom is available.



it's questions like these . . . that get

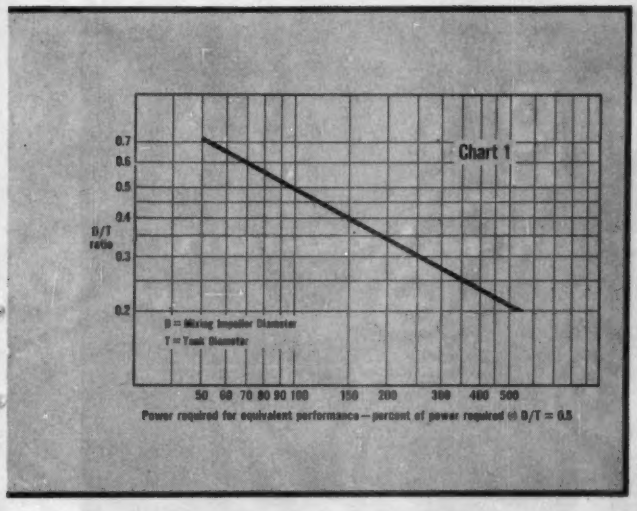


Q. What design factors insure maintenance of drive shaft alignment, even after years of operation?

A. The ability of a shaft to run dead-true, through years of operation, depends primarily upon the design approach of the manufacturer. When extra large, extra high capacity bearings (1) are used, shafts (2) can be larger, stiffer, heavier duty. When other drive components . . . housings (3) bearing supports (4) and gearing (5) . . . are designed for extra strength, shafts will be supported with near-absolute rigidity. Result: damaging shaft deflection simply cannot occur. Gearing is effectively isolated from unbalanced loads.

You will get truer shaft operation at shaft seals.

Whenever alternate offerings are being evaluated . . . and if price and output torque ratings are competitive . . . then the basic design approach of each manufacturer demands careful examination if you are to get full advantage of the savings that result from better performance, less maintenance and longer life.

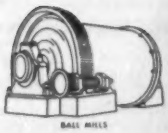


Q. Are "dollars per horsepower" a valid basis for comparing mixer values?

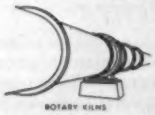
A. No. Mixers having the same horsepower rating and drive efficiency can vary widely in torque rating. Torque applied to the mix is what does the work and torque is what you pay for. When comparing mixer values, the most important first step is that of developing torque ratings of alternate units offered. Using the most familiar units, torque can be calculated as follows:

$$\text{Torque (lb. inches)} = \frac{63025 \times \text{Motor HP}}{\text{Mixer shaft RPM}}$$

The mixer having the lower torque rating must use a higher mixer shaft speed and smaller diameter impeller to maintain a given level of mixer output. This can lead to unsatisfactory performance. However, a mixer of equivalent horsepower rating but with a higher torque rating and larger impeller will do the job well. For an idea of the importance of impeller size, the chart shows the influence of impeller diameter in relation to tank diameter (D/T ratio) upon motor HP required for a specific level of performance in many industrial mixing operations. The bigger impeller at the slower speed (higher applied torque) will be a sounder choice.



BALL MILLS



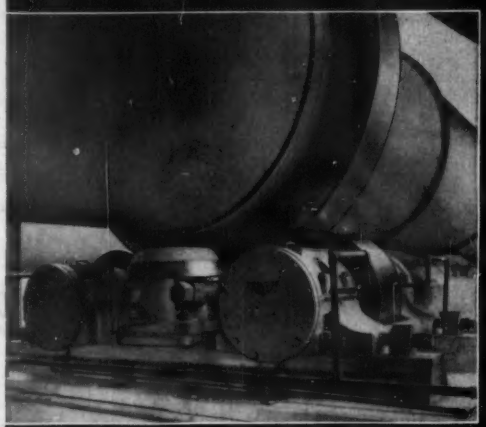
ROTARY KILNS

APRON FEEDERS

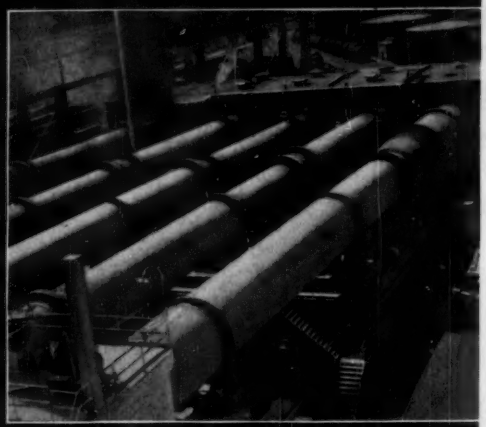
PRIMARY GYRATORY CRUSHERS

TRAYLOR-MADE

is engineering precision



Thrust roller mechanism of an 8'—6" diameter to 7'—10" diameter x 400'—0" Traylor Rotary Kiln.



13'—0" diameter to 10'—0" x 200'—0" Traylor Rotary Kiln.

JAW CRUSHERS

SECONDARY GYRATORY CRUSHERS

Traylor Rotary Kilns have all welded steel shells, feed and discharge end seals, heat recuperating systems for wet process kilns, improved kiln feeders, kiln controls, drives and many other important features. High standards of craftsmanship and soundness of design can be seen in the hundreds of Traylor Rotary Kilns in use by industry today. Write for bulletin No. 1115 today.

Traylor

TRAYLOR ENGINEERING & MFG. CO. 2010 MILL ST., ALLENTOWN, PA.

Sales Offices: New York — Chicago — San Francisco

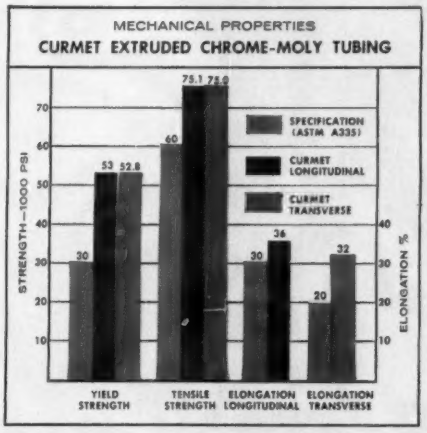
Canadian Mfr.: Canadian Vickers, Ltd., Montreal, P.Q.

CURMET

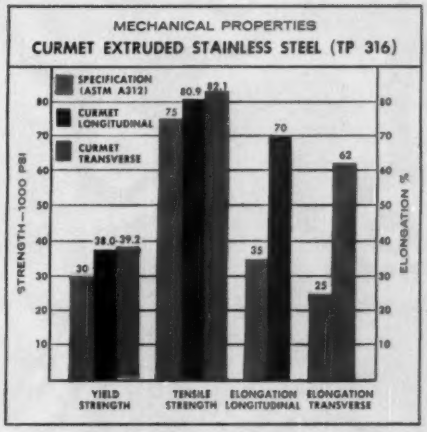
EXTRUSION • CASTING • FORGING • FABRICATION

For Equally High Strength in ALL directions

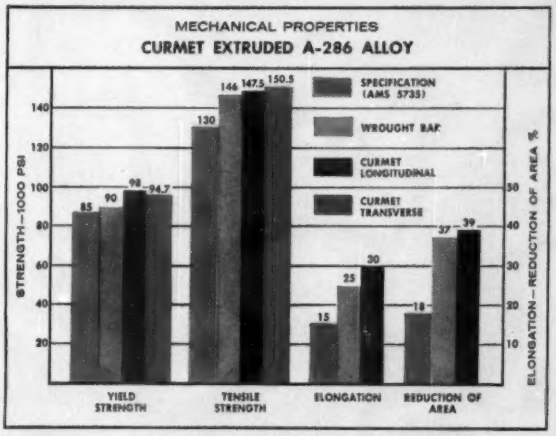
AS SHOWN BY THESE *PRODUCTION* TEST RESULTS



Made by conventional methods, tubing of this alloy would normally show a transverse strength 10 to 30 per cent below its longitudinal strength.



All properties of this CurmeT processed product prove to be not only well above specification, but both transverse and longitudinal strengths exceed the conventionally wrought product.



Extreme resistance of this CurmeT processed pressure tubing to radial stresses is shown by transverse strengths actually higher than the longitudinal. Elongation is 100 per cent in excess of requirement.

Where "hoop strength" or resistance to internal pressures is required in large tubing or pressure vessels, the non-directional properties of CURMET processed ferrous alloys offer a significant contribution. No longer need the designer compensate for the "one-way" strength of conventionally processed tubular products by specifying additional thickness of costly alloys.

The advanced CURMET methods of extrusion, casting, forging and machining developed by the Metals Processing Division have resulted in improvement of physical properties in a wide variety of alloys.

FOR FULL INFORMATION, WRITE TO:

METALS PROCESSING DIVISION
760 Northland Avenue

CURTISS-WRIGHT CORPORATION
Buffalo 15, New York

Take the tedium out of correlation studies with this powerful electronic computer ROYAL PRECISION LGP-30

Large capacity . . . easily programmed and operated . . . mobile . . . low in cost

Compact, simple to use . . . Royal Precision LGP-30 brings high-speed electronic computation *right to your desk* . . . relieves you of the tedium of statistical analysis in such areas as research and product development, quality control and process control. And at the lowest cost ever for a complete computer system!

Faster answers; unusual capacity. Used wherever *you* want it, LGP-30 operates from any conventional wall outlet, is self-cooled. Providing fast, effortless answers for all types of statistical studies—correlations, analysis of variance, regression analysis, curve-fitting – LGP-30 gives you speed and memory (4096 words) comparable to computers many times its size and cost . . . stored-program operation for complete flexibility. Result: you save valuable time . . . handle more assignments . . . go forward to truly *creative* work.

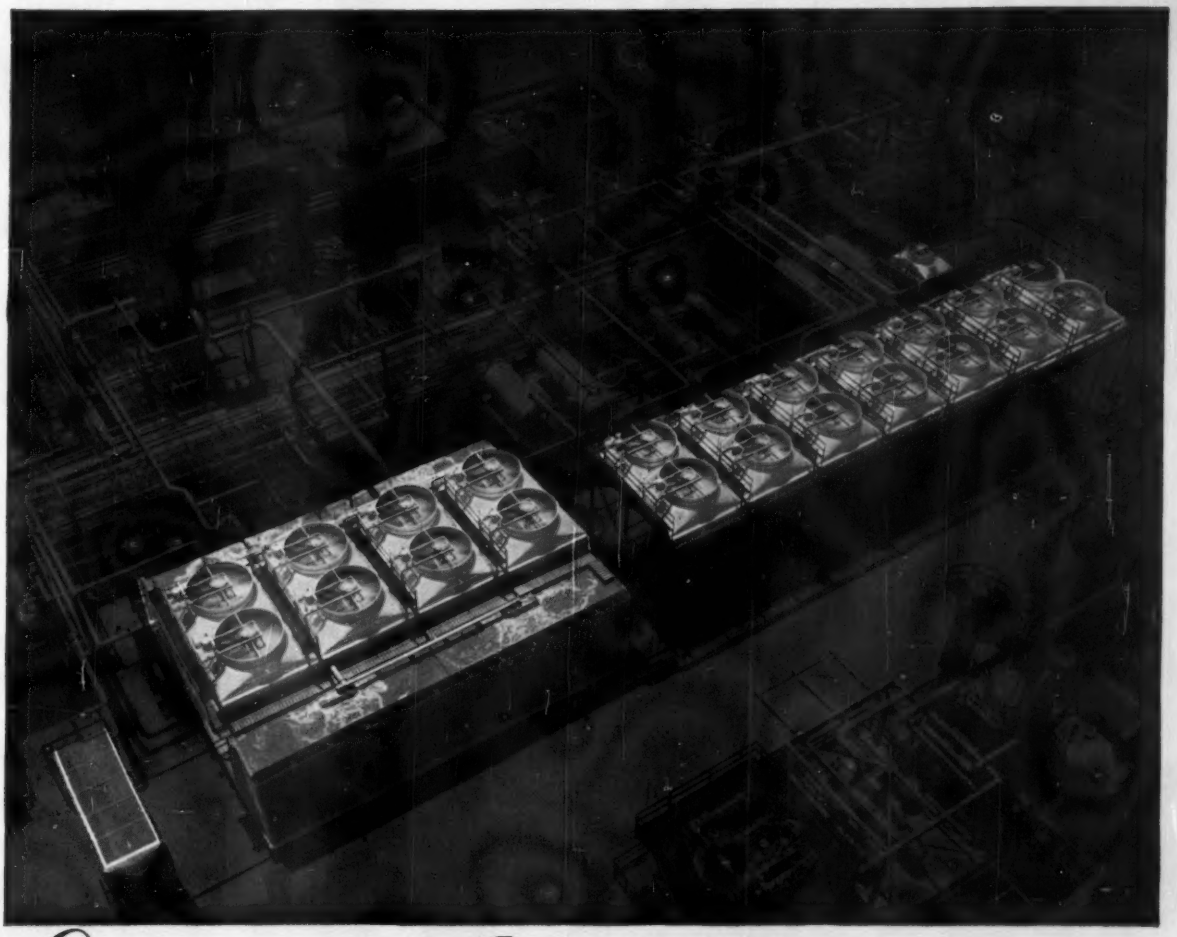
Easy to operate and program. Controls have been so thoroughly simplified, LGP-30 may be operated with only minimum computer experience. Answers are printed out directly . . . do not require deciphering. Programming is easily learned. A library of sub-routines, plus programs for a wide variety of applications (including Box technique for experimental design), are available.

Wide range; exceptional value. The most powerful computer of its size yet developed, LGP-30 is the greatest value in today's market. Remarkably small initial investment is combined with low operating and maintenance costs. Service facilities are available coast-to-coast.

For further information and specifications, write Royal McBee Corporation, Data Processing Equipment Division, Port Chester, N. Y.

ROYAL McBEE

data processing division



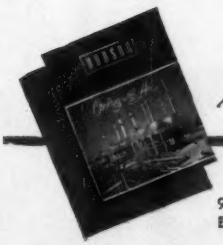
Cooling with Air AND MINIMUM WATER IN A MODERN REFINERY

Process cooling in Cosden Petroleum Corporation's new West Texas refining units is largely by direct use of air. Over 250 million BTU's per hour are dissipated directly to five billion standard cubic feet per day of air moved by 38 fans in HUDSON Solo-aire or Combin-aire units.

Solo-aire units are used where low effluent temperatures are unnecessary. Combin-aire units, in which air is first precooled with water, are used where lower effluent stream temperatures are required. The cooled water from the Combin-aires is available for other cooling services; the Combin-aires in this case performing the further function of water cooling towers. Water spray, carryover or condensation is impossible as the effluent hot air is under saturated with water vapor. Combin-aires are installed adjacent to other process equipment.

These Solo-aires and Combin-aires at Cosden, and hundreds of other HUDSON units in oil, gas and chemical processing plants confirm the advantages of cooling with maximum air and minimum water.

Before finalizing design of new process units, let HUDSON assist you in determining optimum balance in use of air and water.



Air-cooled equipment bulletin mailed upon request

HUDSON
ENGINEERING CORPORATION

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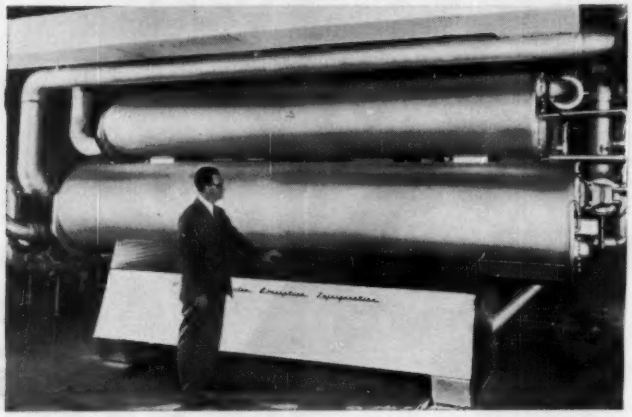


For reliable cooling
from low-cost heat

29 leading U.S. chemical producers use Carrier Absorption Refrigeration

In the last seven years 29 leading U.S. chemical companies have purchased Carrier Absorption Refrigerating Machines. They deliver a total of 19,470 tons of cooling, range in capacity from 60 to 700 tons and help produce such varied products as baby powder, explosives, table salt and vinyl plastics.

Why have these companies chosen Carrier Absorption Refrigeration —and why have so many of them become repeat buyers? One reason: economy. Cooling produced by low-pressure steam or hot water is often the best way to handle refrigeration requirements in a processing plant. Another reason: reliability. For years Carrier Absorption Machines have established an unmatched record for dependability in more than 1000 installations throughout the world.

Of course, there are other reasons. So the next time you need refrigeration, why not call Carrier and get the whole story? Call your nearest Carrier office. Or write Carrier Corporation, Syracuse 1, New York.

BETTER AIR CONDITIONING FOR EVERYBODY EVERYWHERE

Carrier

Automatic STOP-and-GO is just one of many features of the Carrier Absorption Machine. No valves to turn, no switches to throw. Just a single push button for "Stop-and-Go." The human element can be eliminated altogether by use of a time clock or thermostat.

Push Button
Starts and stops the machine at the press of a single button.

Time Clock
Automatically starts or stops machine at any hour you select.

Thermostat
Automatically starts or stops machine at desired temperature.

ADVERTISEMENT—*This entire page is a paid advertisement* *Prepared by U. S. Industrial Chemicals Co.*

U.S.I. CHEMICAL NEWS

Nov. ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1958

Methods for Making Borane Fuels Now Being Piloted

Operation of a high-energy-fuel pilot plant for the Air Force began recently at AFN, Inc., Henderson, Nevada. The company is owned jointly by American Potash, Food Machinery, and the U.S.I. Division of National Distillers (see U.S.I. Chemical News—February 1958).

This new plant is a process development unit designed, engineered and constructed by AFN under Air Force sponsorship to develop a large-scale production method for alkyl borane high energy fuels, materials of great importance to the nation's missile program.

ATTENTION: Users of Specially Denatured Alcohol

Citric acid may now be added to toilet preparations containing tartar emetic to prevent clouding, according to an industry circular issued by the Alcohol and Tobacco Tax Division.

Since issuing the regulation that tartar emetic or sucrose octa-acetate must be added to bay rum, alcoholado, or alcoholado-type toilet waters made with specially denatured alcohol, the Division has discovered that tartar emetic produces cloudiness in formulations.

The Division recommends the use of one-quarter grain of citric acid per fluid ounce of finished product to eliminate cloudiness. The circular says: "Permittees now holding approved formulas for the manufacture of alcoholado or bay rum containing tartar emetic and who elect to add citric acid... need not submit new formulas on Form 1479-A. However, formulas submitted in future for these products in which citric acid is to be used must show such use."

Cetyl Alcohol "Blanket" Lowers Water Evaporation

Researchers have discovered that a one-molecule-thick layer of cetyl alcohol, spread on the surface of water in a reservoir, can reduce evaporation by as much as 65%. A pound of this harmless chemical will cover 10 acres of surface and last about 3 days against the action of wind and dirt. It is calculated that a pound per acre per month provides adequate protection, and that millions of dollars could be saved this way yearly in areas where water is usually in short supply.

Cetyl alcohol acts by spreading over the water surface to seal out air. It must extend to the reservoir banks to be effective. Its self-healing property insures that there will be no uncovered places on the surface for long, should wind or dirt break the coating.

Some practical problems must be solved before usage can become widespread. These include methods of applying and replacing the chemical. One solution being examined involves placing pelletized cetyl alcohol in screens on floats or buoys on the water.

Tests Confirm That Methionine Is Absorbed Through the Skin

Known Healing Properties of Methionine, Plus Proof Of Skin Absorption, Suggest Wide Application in Topically Applied Cosmetics, Toiletries, Medications

It has been established by thorough study that methionine is absorbed by the body when applied to the skin. Radioactive tracer studies made with guinea pigs reveal that administration of methionine by skin has nearly half the efficiency of oral feeding.

Methionine is an essential sulfur amino acid, a precursor of cystine in the skin, hair, nails and other tissues. It has been shown previously that methionine administered orally:

- decreases healing time of surface wounds
- cures some forms of diaper rash
- aids in disappearance of warts
- protects against radiation damage
- helps reduce tumor growth
- overcomes urinary infections

Experience with topical application has revealed that methionine:

- promotes rapid healing of burns and other wounds
- heals varicose leg ulcers
- promotes good skin tone
- has helped in treatment of falling hair

Now that definite experimental data has been compiled on the rate and extent of methionine absorption through the skin, it is felt that its healing properties can be utilized

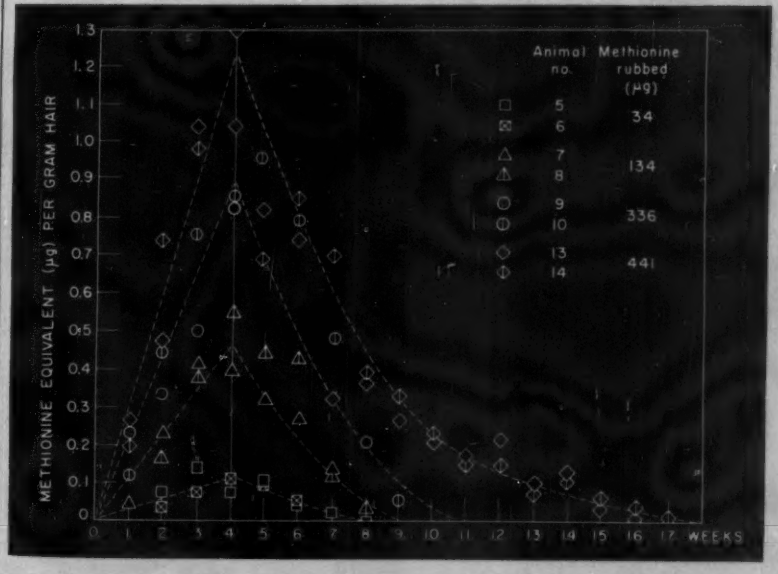
MORE

Esters of ISOSEBACIC® Acid Compare Well with Other Vinyl Plasticizers

Octyl esters of the new U.S.I. ISOSEBACIC acid have been evaluated against accepted vinyl plasticizers in a complete series of tests at the U.S.I. laboratories. The performance results have been coupled with current price information to yield comparisons which should be of interest to makers of vinyl plasticizers.

Here are the conclusions. Octyl isosebacates are less expensive than sebacates and are closely competitive in overall performance. They have an edge over azelates on cost and are about equal in performance. While comparing closely on cost with adipates, they are better on overall performance.

ISOSEBACIC acid is a new synthetic intermediate developed by U.S.I. — a mixture of 2-ethyl suberic, 2, 5-diethyl adipic and sebacic acids. It will soon be available commercially from a new U.S.I. plant at Tuscola, Ill.



Uptake of methionine (S^{35}) in hair of rubbed guinea pigs. (Edwards, L. J.: *Nature*, 173, 1042)

Nov. ★ **U.S.I. CHEMICAL NEWS** ★ 1958

CONTINUED *Methionine*

extensively by formulators of cosmetics, toiletries and topically applied medications. Creams and lotions to maintain skin tone, treat burns and sunburn, and hasten the healing of minor cuts, scratches and abrasions are among the possibilities. Incorporation into baby talcs, after-shave lotions and men's hair preparations is also indicated. The possibilities are many.

Test Procedures

Here's how the tests were made. Methionine labeled with a radioactive sulfur (S^{35}) tracer was applied in aqueous solution to a shaved area on the backs of the test guinea pigs by gentle rubbing. The same solution was also injected intramuscularly into a second group of guinea pigs, and fed orally to a third group. Hair from the treated animals was clipped at weekly intervals, washed, and its radioactivity determined. The per cent of absorption by these three methods of application were, respectively, 1%, 3-5%, and 2%, based upon the test results.

The animals subjected to topical application were treated four days a week for four weeks. Their hair showed a steady build-up of radioactivity during this time. When application was stopped, radioactivity declined steadily. The chart on the preceding page shows the curve.

New Surface Treatment for Polyethylene Makes It Receptive to Printing Ink

A new chemical treatment for giving the surface of polyethylene an affinity for printing inks is outlined in British Patent 772,803. Two types of chemical solutions are mentioned:

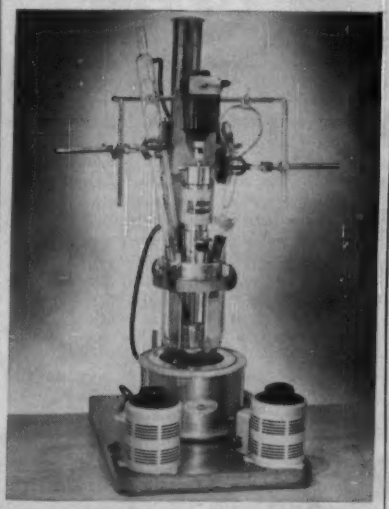
(1) A 4% aqueous solution of a permanganate containing 10-30% by weight of sulfuric acid. A brown permanganate stain results which can be removed with potassium bisulfite without affecting film's receptiveness to ink.

(2) A 30% aqueous solution of a chromate or dichromate containing not more than 30% by weight of sulfuric acid. Both chemical treatments are followed by washing and drying.

New High-Speed Stirrer For Dispersing Sodium

A new unit, designed to apply high-speed stirring to many types of small-scale chemical reactions, has been tested and found satisfactory for dispersing sodium. As part of a research program on preparation and uses of sodium in dispersed form, the U.S.I. laboratories have evaluated the new Chemtor Dispersion Reactor and have found that it compares favorably with other small-scale units suggested in the U.S.I. literature (see the 42-page U.S.I. brochure "Sodium Dispersions" for complete discussions of Cowles Dissolver, Premier Mill Dispersator, Waring Blendor).

The Chemtor Dispersion Reactor, like the others, can be used to increase the surface area of sodium — for faster reactions and higher yields — in Claisen condensations, Wurtz-type reactions, purifications, metallations, preparation of sodium alcholates, preparation of alkyl and aryl sodium, polymerizations and replacement of acidic hydrogen.



Chemtor high-speed dispersion reactor system.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

Powdered replacement for liquid acids just introduced is blend of acid salts, activators, surfactants. Acid solutions prepared by dissolving in water. Suggested for activating metals before plating, and as pickling agent. **No. 1410**

Barium chloranilate reagent powder for sulfate determinations is now being marketed. Reduces working time to one half hour maximum, it is claimed. Suitable for analyses of water, petroleum products, many other materials. **No. 1411**

New gamma-sensitive scintillation detector is specially designed for medical diagnostic use of radioisotopes. Is said to be ideally suited for thyroid or kidney function studies, cardiac output determinations, 3-D body scanning. **No. 1412**

Feed industry outlook for next 50 years — covers expected advances in farm economics, biochemical developments, feed automation, liquid supplements, etc. in reprint form. **No. 1413**

New rauwolfia alkaloid raubasine is now available in commercial quantity. Product is also known as ajmalicine, delta-yohimbine and tetrahydroserpentine. **No. 1414**

High purity 2-butene and 1-butene concentrates are now commercially available. The 2-butene contains no isobutylen. , 0.5% max. 1-butene, 1% max. butadiene, 96% min. 2-butene, balance n-butane. The 1-butene contains 5% max. isobutylene, 60% min. 1-butene, balance butanes. **No. 1415**

Disposable-paper temperature indicators for 100, 105, 110°F can now be obtained. Work by irreversible color change. Developed for measuring temperatures attained by heat-sensitive biologicals, etc. in storage and transit. **No. 1416**

Cholesterol's chemistry, biochemistry and pathology are detailed in a new, 542-page book which can now be purchased. Prepared by an international group of authors, book gives complete picture of present knowledge on compound. **No. 1417**

Small-capacity pump or meter designed to fit conventional laboratory stirring motor drives is now on market. Mounts on same ring stand as such motors. Said to handle small flows of Chemical liquids, slurries, pastes. **No. 1418**

Proceedings of Sixth International Conference on Spectroscopy (May 1956) have recently been published as a supplement to Spectrochimica Acta, 1957 and offered for sale. Includes papers on UV absorptiometry, IR spectroscopy, emission, spectrometry. **No. 1419**

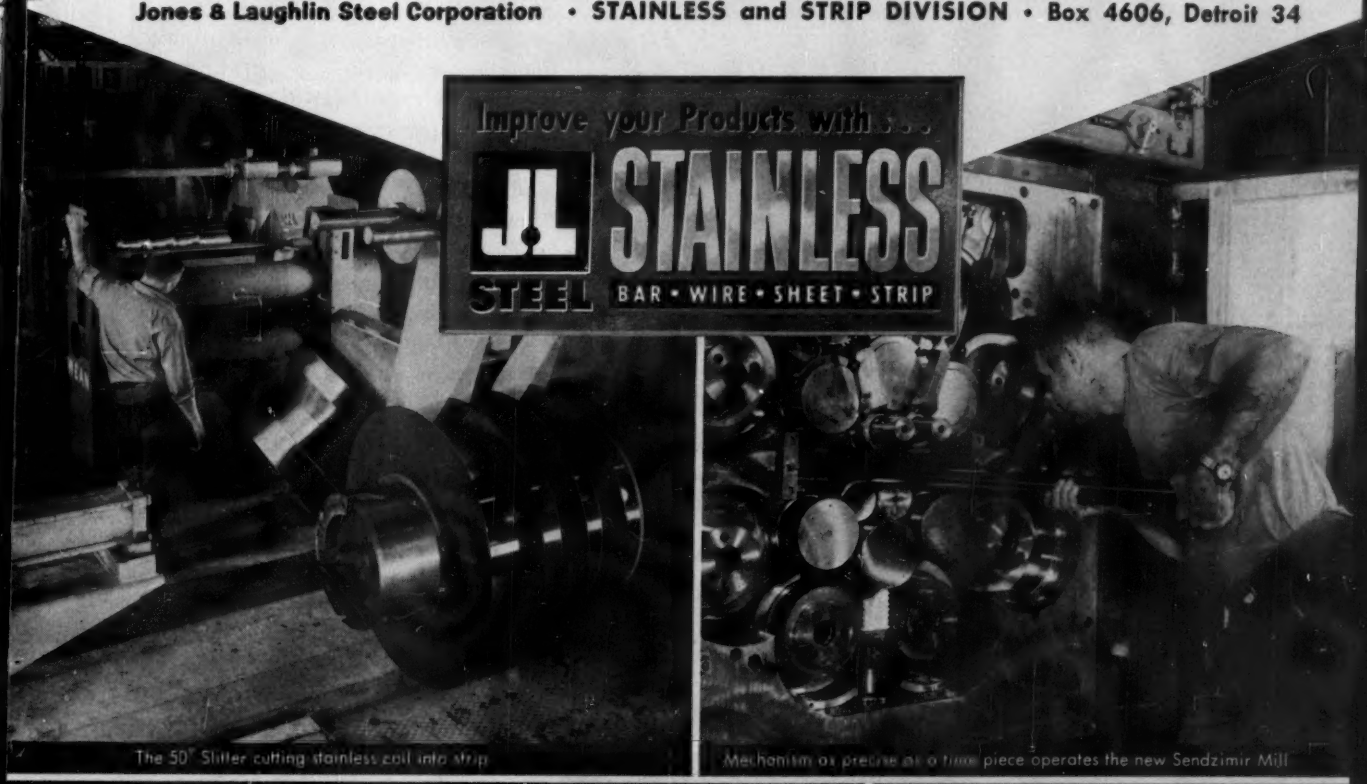
A PREVIEW

OF A NEW SOURCE OF QUALITY STAINLESS SHEET & STRIP

Steel buyers everywhere will welcome J & L's new source of constant high quality stainless sheet and strip. The completely new stainless mill, located at Louisville, Ohio, has successfully passed through its shake-down runs and is now ready for *full* capacity production.

With the completion of this integrated cold rolling operation, J & L is equipped with the finest facilities in the industry to produce stainless steel strip and sheets to extremely close tolerances in widths up to 48 inches. *Write for your copy of J & L's Sheet and Strip Manual today.*

Jones & Laughlin Steel Corporation • STAINLESS and STRIP DIVISION • Box 4606, Detroit 34



The 50" Slitter cutting stainless coil into strip

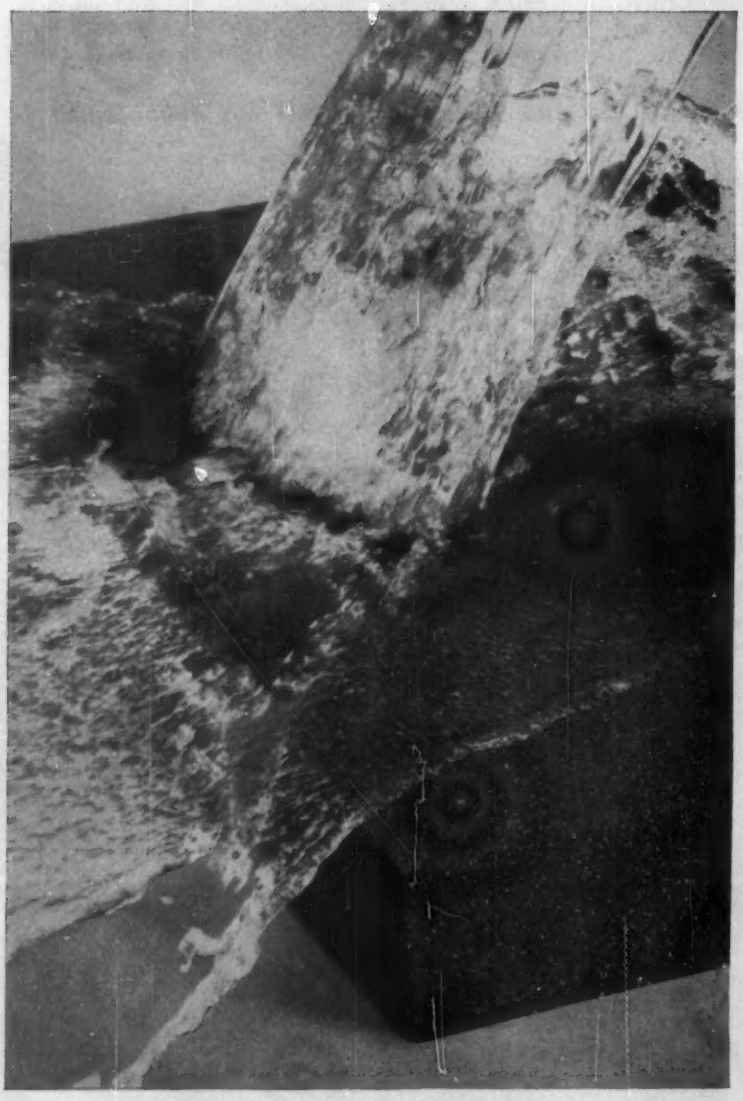
Mechanism as precise as a fine piece operates the new Sendzimir Mill

Discharge end of the cold roll anneal and pickle line

Gauge is closely checked on the Temper Mill

Only cellular glass insulation

FOAMGLAS® IS THE ONLY



Whether you insulate building roofs and walls, piping or equipment, you can seldom anticipate *all* of the conditions to which your insulation will be exposed after installation. Humidity conditions change. Temperature control needs vary. Even the original use for insulated space or equipment may alter. That's why the ideal thermal insulation must give you a *combination* of key benefits . . . in order to serve satisfactorily under all possible conditions.

Most important, the ideal insulation must be impervious to water vapor as well as liquids—in order to insure constant performance under all humidity exposures. It should be proof against acids and acid vapors. It should be incombustible . . . dimensionally stable . . . impervious to vermin . . . strong enough for a variety of structural uses. Just one insulation—cellular glass—meets all of these qualifications.

FOAMGLAS is the only cellular glass insulation.

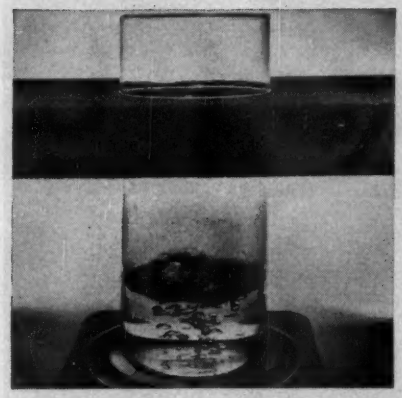
FOAMGLAS may well be the one satisfactory solution to all your insulating problems. For detailed literature, write—specifying your particular insulation requirements—to Pittsburgh Corning Corporation, Dept. H-118, One Gateway Center, Pittsburgh 22, Pennsylvania.

PC Glass Blocks and FOAMSIL® are other outstanding products of Pittsburgh Corning.

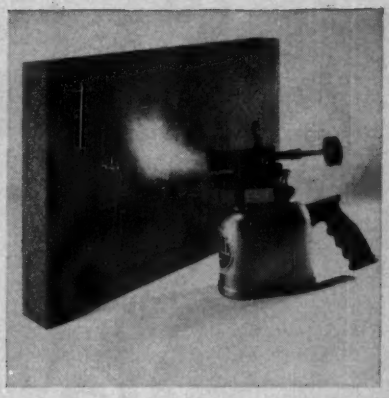
P I T T S B U R G H

gives you all these key benefits

CELLULAR GLASS INSULATION



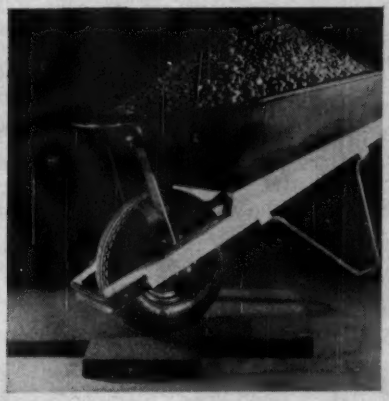
Moisture-proof! The minute liquid or vapor enters an insulation, it begins to lose its insulating value because moisture conducts heat. FOAMGLAS, a material composed entirely of sealed glass cells, is completely impervious to all moisture. Its K factor—measure of insulating performance—never varies.



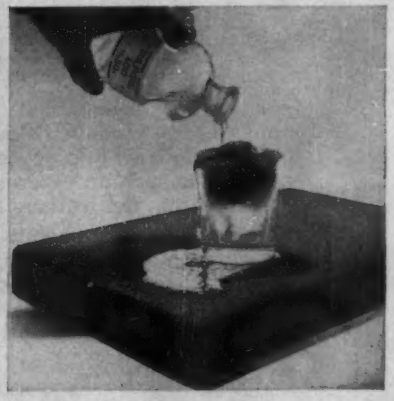
Can't Burn! Smoldering insulation in walls or roof of a building is a deadly fire hazard, hard to detect, difficult to control once detected. FOAMGLAS eliminates this hazard because it is the only insulation composed entirely of incombustible glass. This may even mean lower fire insurance rates in some cases.

Dimensionally Stable! Most insulations tend to warp, swell, shrink or slump after they are installed. This causes open joints in the insulation . . . insulation voids that create a serious loss of efficiency. There is no such difficulty with FOAMGLAS. This all-glass insulation always maintains absolute dimensional stability.

Vermin-proof! Most insulations offer no protection at all against vermin in food processing, storage or handling operations. Rats and other vermin gnaw right through them. FOAMGLAS, on the other hand, affords an excellent vermin barrier. Its all-glass composition offers no food or nesting materials for vermin.



Strongest! FOAMGLAS has a compressive strength of over 7 tons per square foot (av. ult.). It forms a solid base for built-up roofing. It makes possible the placing of insulation beneath heavily loaded floors. And high strength FOAMGLAS permits such cost saving design innovations as free standing walls and partitions.



Acid-proof! There is often a lot of acid around a processing operation. Even the atmosphere around processing plants frequently has a high acid content. Acids will attack and destroy most thermal insulating materials, but they won't harm FOAMGLAS. This unique all-glass material is completely impervious to all common acids.

pc CORNING

Rugged, Sensitive Temperature Transmitter

Measuring Spans
of 50°, 100°, 200°, 300°, and 400° F. are easily set as required within over-all transmitter range of —100° F to +1000° F.

Stable Operation
Single lever, single pivot, force-balance system provides stable, friction-free operation.

Fast Response
Highly sensitive, low-volume, gas-filled bulb and minimum length capillary assure maximum speed of response.

High Accuracy
Full compensation for ambient temperatures and pressures helps maintain highest calibrated accuracy.

Low Cost Installation
Standard 3-15 psi output signal requires only low cost tubing for transmission to any recorder or controller.

. . . IMPROVES REMOTE CONTROL

There's no easier, simpler way to measure remote temperatures, over so wide a range, with such high sustained accuracy and speed, and at so low a cost!

The Foxboro Type 12A Pneumatic Temperature Transmitter converts temperature measurement to a linear output signal, which is transmitted to any standard 3-15 psi recorder or controller. Fully compensated for ambient temperatures and pressures, this rugged, highly responsive instrument performs outstandingly under the most severe conditions. And it's insensitive to mechanical vibration.

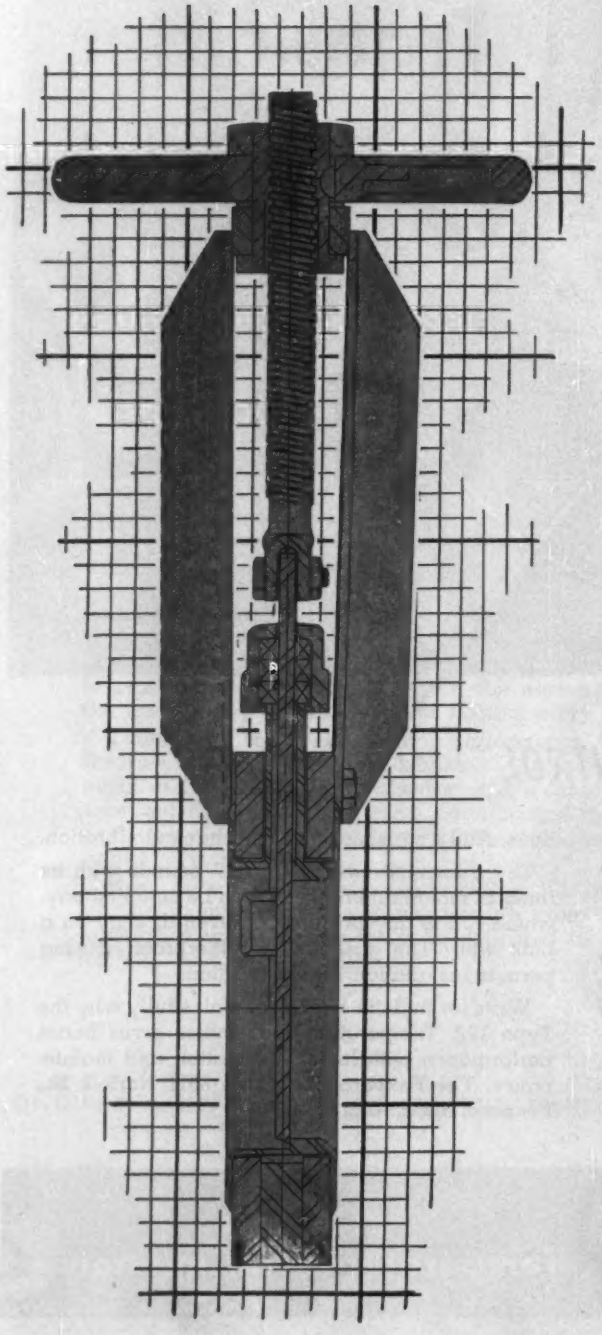
The transmitter weighs only 7 pounds with its integral mounting bracket. It can be mounted anywhere . . . in any position . . . even directly on a bulb well! The gasketed, weatherproof housing permits installation in any location.

Write for Bulletin 13-17. It explains fully why the Type 12A Temperature Transmitter gives better performance with lower installation and maintenance. **The Foxboro Company, 3611 Norfolk St., Foxboro, Mass., U.S.A.**

FOXBORO
REG. U.S. PAT. OFF.

Pneumatic Temperature Transmission

The LOW COST of Valving...



The processing of corrosive chemicals — the handling of acid or alkaline services—has always required expensive valves . . . until now!

But now . . . ! DeZurik Fabricated Knife Gate Valves have *high* resistance to corrosion at a low, low cost.

Only the parts coming in contact with the flow utilize high alloys. The remaining structural portions of the valve are produced in mild steel or in other economical metals. (Fabricating out of plate material also eliminates the porosity of cast metal valves.)

Their light weight drastically reduces installation costs and their bonnetless design all but eliminates maintenance expense. Yet their rugged construction withstands piping strains and line pressure.

They're available in a wide range of metal combinations and in several different styles. A full complement of operators is also available.

For more information, see the DeZurik representative in your area . . . or write for Bulletin 300.

DeZURIK CORPORATION
SARTELL, MINNESOTA

YARWAY impulse®

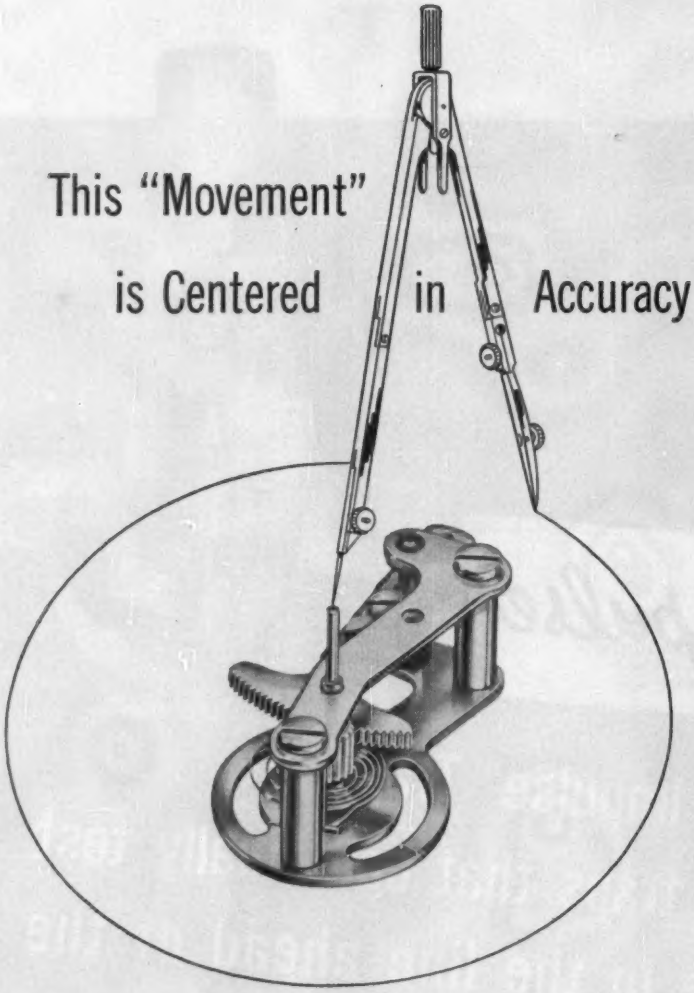
Yarway Impulse* Traps are the only steam traps that continually test for condensate in the line ahead of the trap and operate to discharge it as soon as it forms.

You gain by higher temperatures, steadier temperatures, peak operation of steam heated equipment at all times.

*. . . A COMPLETE LINE OF STEAM TRAPS, ALL OPERATING ON A PROVEN THERMODYNAMIC PRINCIPLE.

Manufactured by YARNALL-WARING CO., 125 Mermaid Avenue, Philadelphia 18, Pa.
Stocked and sold by 270 Industrial Distributors.
Write for free bulletin "The Why and How of Steam Trapping."

This "Movement" is Centered in Accuracy



The rotary movement in Ashcroft Duragauges has a geared center shaft on which the pointer is mounted. When pressure flexes the Bourdon tube, the pointer is always positively positioned. You can rely on the Duragauge for precise accuracy in measuring pressure no matter how severe the conditions of service.

Correct calibration is guaranteed: the one-piece link between movement and Bourdon tube prevents slippage or parting under tension. Recalibration is easy from front or rear. Universal adjustability permits uniformly graduated dials.

You can order Ashcroft Duragauges with all-stainless-steel movement or stainless steel with nylon bearings and pinion gear. A complete choice of Bourdon tube materials, pressure ranges, dial sizes and case designs and materials is available. Your industrial supply distributor will gladly help you select the best combination for your requirements. So, be certain of highest sustained accuracy, durability and economy – specify Ashcroft Duragauges.

Ashcroft Duragauge in Alumalife® case—a lifetime case made of special aluminum alloy.

MAXWELL MM&M MANNING & MOORE INC. TRADE MARK

ASHCROFT PRESSURE GAUGES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

A TURN FOR THE BETTER will take

place in your plant when you use this compact TL-6 TRACTOLOADER* to transport materials. Practically turns on a dime — ideal for unloading boxcars and for moving bulk materials through narrow aisles and doorways. Turns from a 7½-ft aisle into a 6-ft doorway! Has power steering, a torque converter and a 15-cu ft tip-back bucket. Other TRACTOLOADERS up to 2 cu yd — 2 and 4-wheel drive. Sold and serviced by Allis-Chalmers dealers.

*TRACTOLOADER is a registered Tractomotive trademark.

Send For Free Descriptive Literature

TRACTOMOTIVE

TRACTOMOTIVE CORPORATION, DEERFIELD, ILLINOIS

Tractomotive Corporation, Dept. C
Deerfield, Illinois

☐ Please send TRACTOLOADER literature
☐ Have salesman call

Name.....

Title.....

Company.....

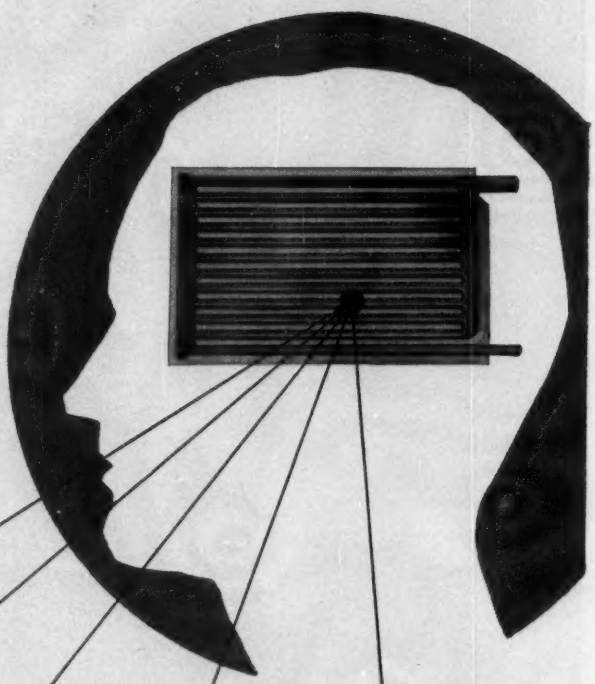
Address.....

City..... State.....

FORMULA FOR SPECIAL HEAT TRANSFER PROBLEMS

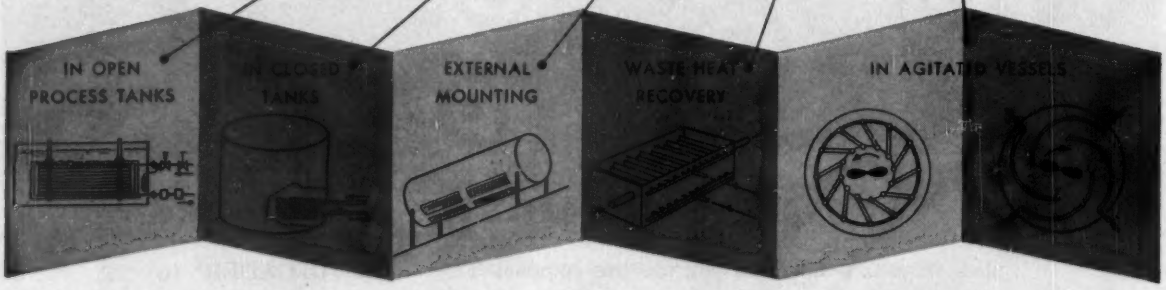
your imagination plus

PLATECOIL®



The simplicity and versatility of Tranter PLATECOIL heat transfer equipment may be just what you've needed for your special heat transfer problems.

A Tranter PLATECOIL consists of two embossed metal sheets, seam and spotwelded together to form channels for the passage of heating or cooling media. Compact, lightweight PLATECOIL units are furnished in a wide range of standard sizes and styles.

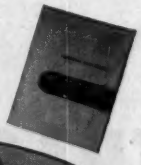


PLATECOIL requires about half the space required by pipe coils and accomplishes heat transfer fully 50% faster than pipe coils.

PLATECOIL units are available in Cold Rolled Steel, Stainless Steel, Carpenter 20, Monel and other corrosion-resistant alloys.

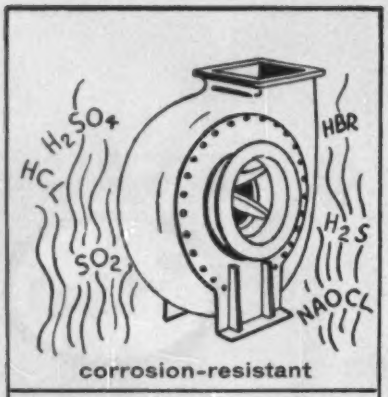
In addition to the many standard styles and sizes, PLATECOIL units can be tailored to fit your exact specifications. Factory fabricated groups, units rolled to specific diameter and units flat on one side are available. PLATECOIL can be galvanized, metallized, electro-polished, polished for food service, prepared for various finishes and furnished with special connections.

SEND FOR FREE TECHNICAL DATA MANUAL P61
FOR COMPLETE ENGINEERING DATA

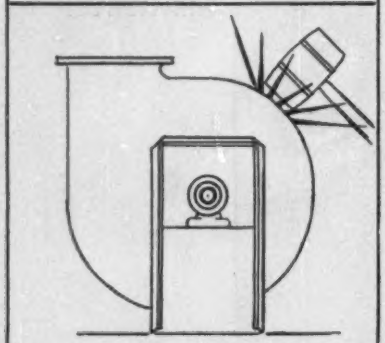


Tranter Manufacturing Inc.
LANSING 9, MICHIGAN

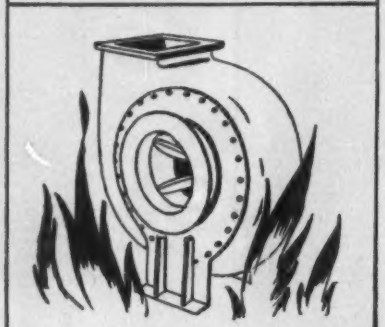
PLATECOIL® DIVISION



corrosion-resistant



impact-resistant



won't support combustion

"BUFFALO" RESIN-BONDED FIBER GLASS FUME FANS

These new fans further broaden the selection of "Buffalo" exhausters for the chemical industries, and offer advantages of versatility, lighter weight, reasonable cost and reliability.

The new Type "FG" offers excellent chemical resistance to a wide variety of acids, salts, gases, organic materials and other corrosives. It is suitable for temperature applications up to 225°F.

The fan housing is entirely of resin-bonded fiber glass, with stainless steel studs molded-in for attachment to the bearing stand. The rotor is a carefully balanced steel wheel with all exposed parts encased in thick fiber glass. In standard capacities up to 34,000 cfm at pressures to 10″ static. Write for Bulletin FI-511 for all details, including chemical resistance table and "Q" Factor* construction details.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY

BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

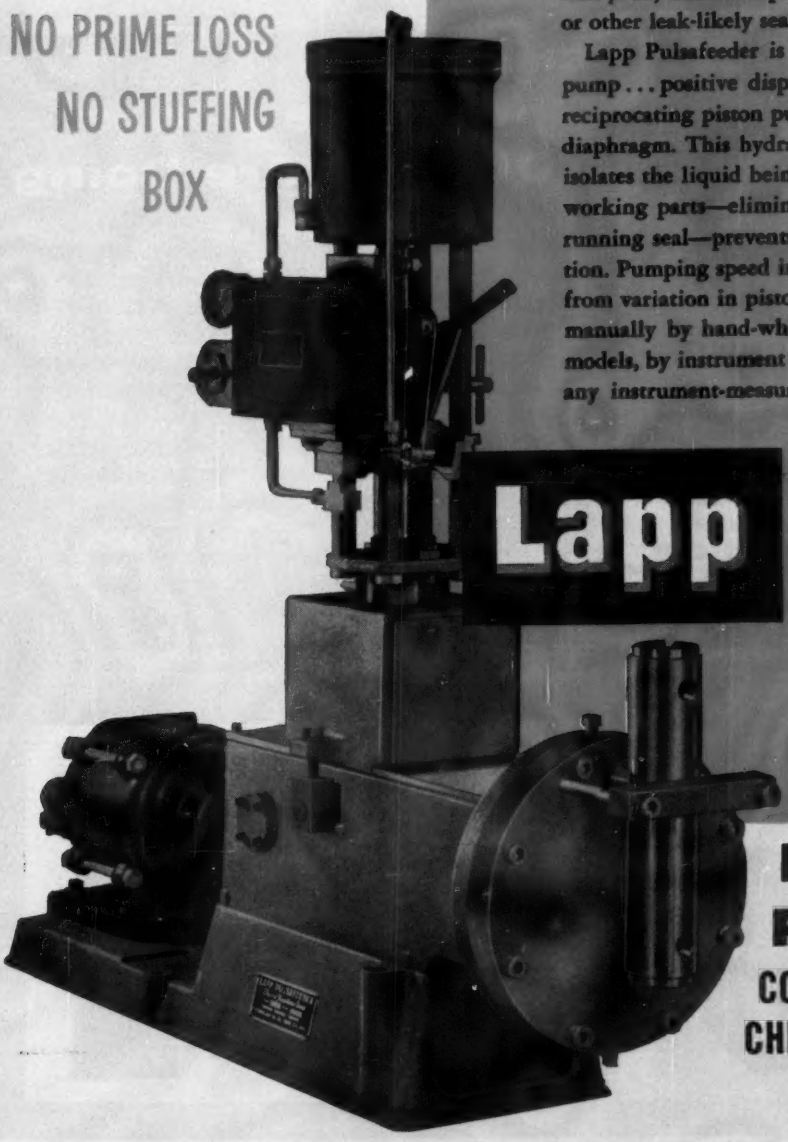
VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Replace with PULSAFEEDER for Trouble-Free Liquid Metering

NO LEAKAGE
NO CONTAMINATION
NO PRIME LOSS
NO STUFFING BOX

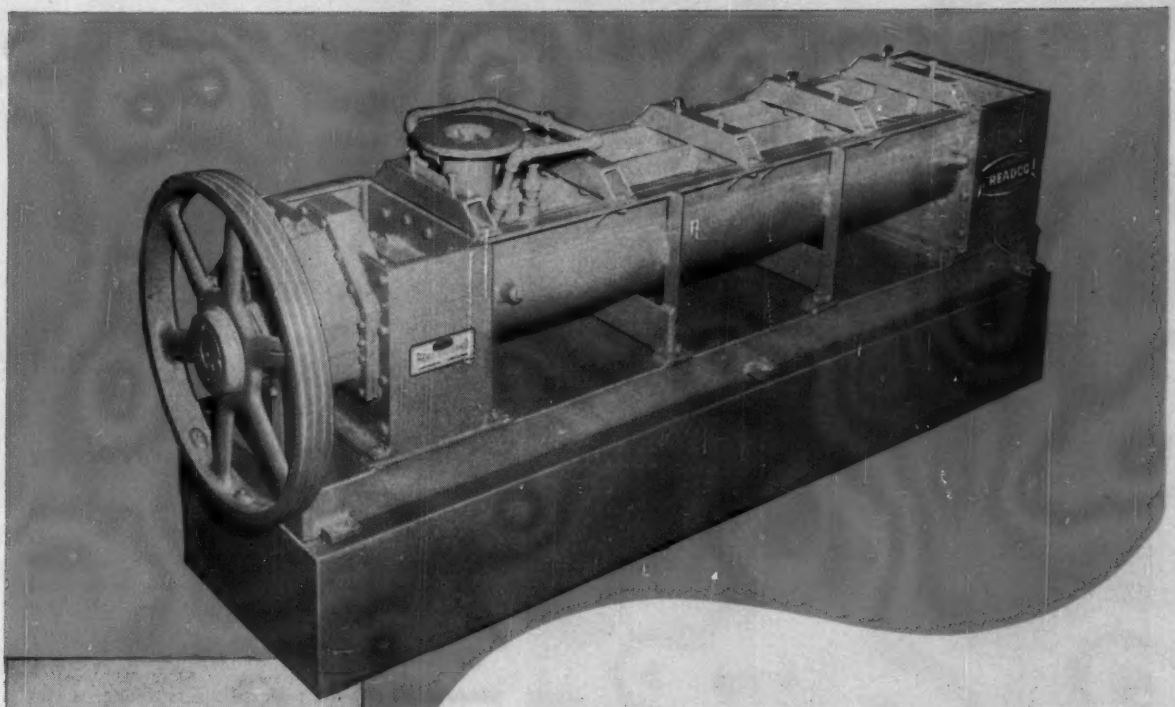
When the time comes to replace the chemical pump in your process, replace with a PULSAFEEDER—the *leak-proof* chemical pump that has *no stuffing box* or other leak-likely seal.

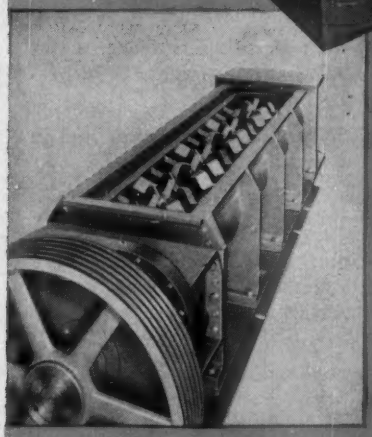
Lapp Pulsafeeder is a combination piston-diaphragm pump . . . positive displacement is achieved by a reciprocating piston pumping a hydraulic oil against a diaphragm. This hydraulically balanced diaphragm isolates the liquid being pumped from the pump's working parts—eliminates need of stuffing box or running seal—prevents product leakage and contamination. Pumping speed is constant, variable flow results from variation in piston-stroke length . . . controlled manually by hand-wheel, or, in Auto-Pneumatic models, by instrument air pressure responding to any instrument-measurable process variable.



WRITE FOR BULLETIN 440 *with typical applications, flow charts, description and specification of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Division, 3604 Poplar Street, Le Roy, N. Y.*

Lapp PULSAFEEDER
CONTROLLED-VOLUME CHEMICAL PUMP





READCO

3 CUBIC FEET A MINUTE

Perfectly Mixed!

Speed production, lower costs...automatically with Readco Continuous Double Arm Mixers

You can step up production and reduce costs of processing dense and viscous materials with this rugged Readco mixer. Built for continuous, automatic operation, it will turn out ½ to 3 cubic feet per minute . . . in a completely homogeneous mix.

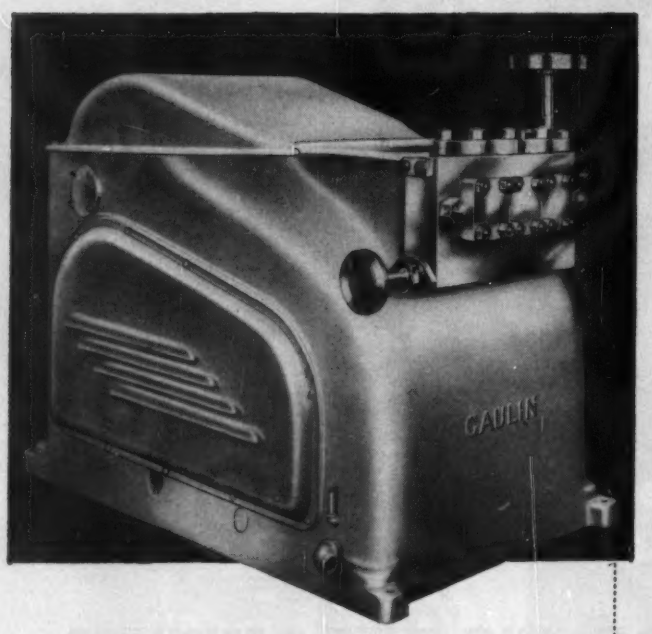
Overlapping action of mixing paddles fully disperses ingredients while moving them along to discharge. Temperature controlling jackets for heating and cooling are standard equipment.

For further information on Readco mixing equipment, see Chemical Engineering Catalog pages 1483 to 1490.

Whatever the mixing job: a READCO mixer!

READ STANDARD
York, Pennsylvania
A Division of
Capitol Products Corporation

There's a GAULIN Triplex Pump for every job



With Maintenance-Saving Horizontal Design Stainless Steel Construction

For Transfer, Metering, Spray Drying

A Gaulin Triplex Pump is a rugged, heavy-duty machine built to minimize operating, inspection, and maintenance costs. Compact. Simple. Dependable. Its horizontal design positively separates your product from the crankcase . . . and makes every part easy to get at.

Just lift two plates and a Gaulin drive and plunger assembly is convenient for inspection or repair.

A Gaulin Cylinder may be disassembled in a matter of minutes.

Vibrationless. A Gaulin is practically free of vibration.

Corrosion-proof. All product contacting parts are stainless steel. Ceramic plungers or other materials are available for special applications.

Rugged Dependability. Thousands of installations with well-known companies prove a Gaulin provides unusually long service at minimum cost.

Write for Bulletin

Name Your Capacity

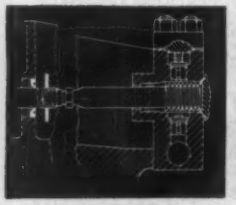
There's a Gaulin to handle your capacity from 50 GPH up to 6500 GPH.

Name Your Pressure

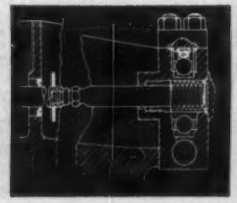
Gaulins are designed for 3 basic pressure ranges — from 500 to 12000 psi.

Name Your Product

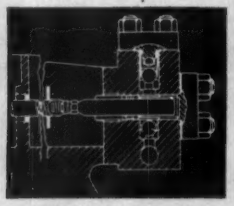
Only Gaulin designs a specific cylinder to handle every product efficiently, economically. Note some of our designs below.



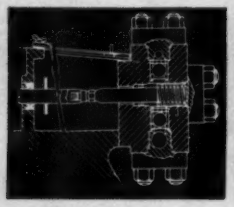
For Fluid, non-abrasive products the Gaulin Spring-Loaded Poppet Valve provides low initial cost and low maintenance.



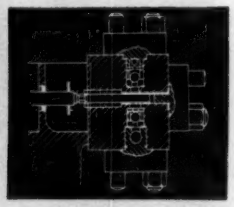
For Viscous, heavy-bodied products, the Gaulin Ball Valve (spring-loaded packing, inserted seats) provides excellent pumping efficiency and minimum maintenance.



For Slightly Abrasive, viscous products, the Gaulin Ball Valve (adjusting screw packing, inserted seats) keeps maintenance costs down.



For Slightly Abrasive, viscous products, where maintenance must be accomplished in minutes, the Gaulin Ball Valve with removable seats (spring-loaded packing) cuts maintenance time to the bone.



For Very Abrasive products, the Gaulin Ball Valve (with adjusting screw packing, removable seats) provides the ultimate in low cost maintenance.

Gaulin TRADE MARK

Manton-Gaulin

Manufacturing Company, Inc., 71 Garden St., Everett 49, Mass.

WORLD'S OLDEST AND LARGEST MANUFACTURER OF HOMOGENIZERS, COLLOID MILLS, TRIPLEX STAINLESS-STEEL HIGH PRESSURE PUMPS

A hot steel circle ready for Claymont's 3000-ton head press. This precision machine is capable of hot or cold pressing heads up to 10 feet in diameter in a wide variety of metals. Integrated facilities make Claymont a reliable source of quality steel plate and plate products for industry.

by d'Arazien

CLAYMONT PRESSED HEADS

CF&I

CHECK CLAYMONT FOR—Alloy Steel Plates • Carbon Steel Plates • Stainless-Clad Steel Plates High Strength Low Alloy Steel Plates • CF&I Lectro-Clad Nickel Plated Steel Plates • Pressed and Spun Steel Heads • Manhole Fittings and Covers • Fabricated Steel Products Large Diameter Welded Steel Pipe

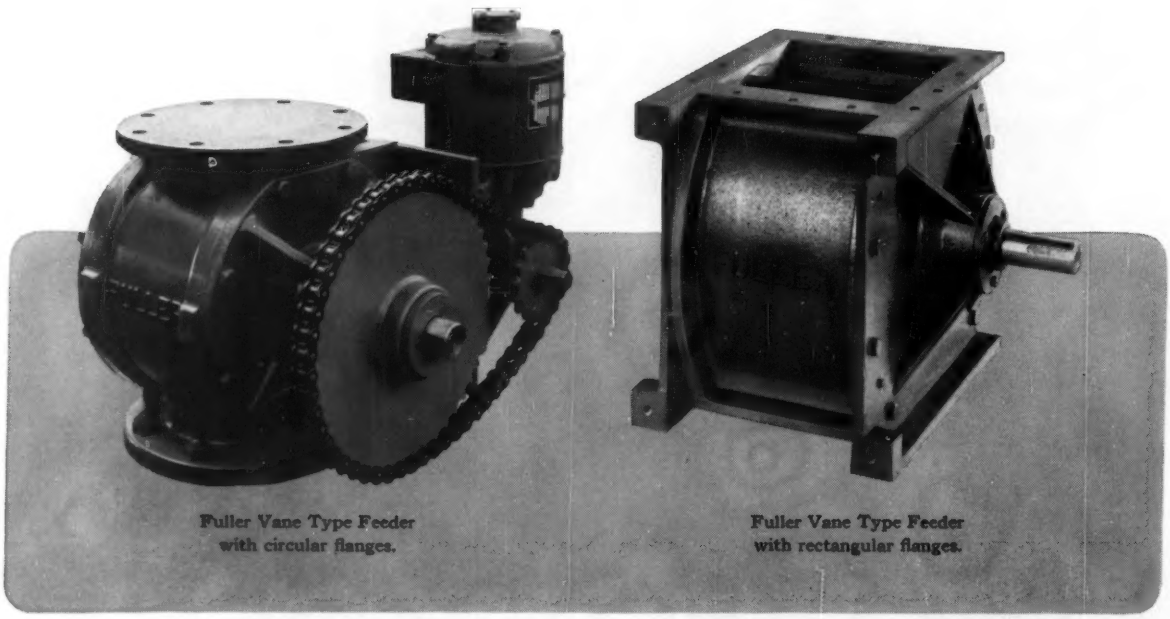
PRODUCTS OF WICKWIRE SPENCER STEEL DIVISION • THE COLORADO FUEL AND IRON CORPORATION

Plant at Claymont, Delaware • Sales Offices in all Key Cities

5744

Fuller Feeders
Keep Conveyors Flowing Freely

. . . whether the load
is a few pounds a minute
or many tons an hour



Fuller Vane Type Feeder with circular flanges.

Fuller Vane Type Feeder with rectangular flanges.

Fuller Vane Type Feeders assure you of dependable handling of dry, pulverized and granular materials. They're available in capacity ranges to meet all normal plant requirements, and are built with circular or rectangular outlets. Check these Fuller cost-saving features . . .

Extra-rugged construction. Heavy, cast iron body walls and headplates add rigidity, longer life. Stainless or other metals can be used where sanitary or corrosion requirements demand their use.

Sealed bearings are equipped with Alemite fittings for ease of lubrication and long life. Abrasive particles can't enter, maintenance is cut.

Make effective air locks. Fuller Vane Type Feeders can be used as air locks for pressure differentials up to 3½ lbs.

Stuffing boxes and ball bearings for vacuum, low-pressure and general applications.

And, where extreme volumetric accuracy without pulsation is needed, there's a line of Fuller Roll Type Feeders. For full details on Fuller Feeders write for Bulletin.

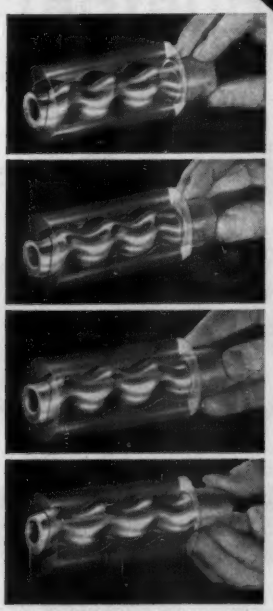
See Chemical Engineering Catalog for details and specifications . 1306 F-20

FULLER COMPANY GENERAL AMERICAN TRADE MARK

Fuller
. . . pioneers in harnessing AIR

FULLER COMPANY
134 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
Birmingham • Chicago • Kansas City • Los Angeles • San Francisco • Seattle

MOYNOS®
SLASH PUMP MAINTENANCE COSTS



PROGRESSING CAVITY PRINCIPLE
A screw-like rotor revolves in a double threaded helical stator creating smoothly moving cavities.

Moynos pump "problem" chemicals that ruin other pumps!

Moyno Pumps have increased production and greatly lowered downtime on many chemical jobs where they replaced other type pumps which had run up prohibitive maintenance costs or failed completely.

Moynos can pump any chemical that can be forced through a pipe, whether a thin watery slurry or an extremely viscous material like rubber dough. A rugged screw-like rotor turning inside a double threaded stator forms "progressing cavities" which move chemicals smoothly. Fluids are pumped without turbulence or agitation. Discharge is uniform, nonpulsating.

Moynos last longer on tough chemical duty because the rotor and stator can be made of special materials that resist the tortures of abrasion and corrosion. Moynos need few or no repair parts . . . show little wear, even after long service.

If you are moving chemicals by hand or other expensive means because they're considered "unpumpable" . . . or if you want to decrease present pumping costs on "problem" chemicals, send us an outline of your problem today. Write for your free Moyno Pump Bulletin 30-CE.

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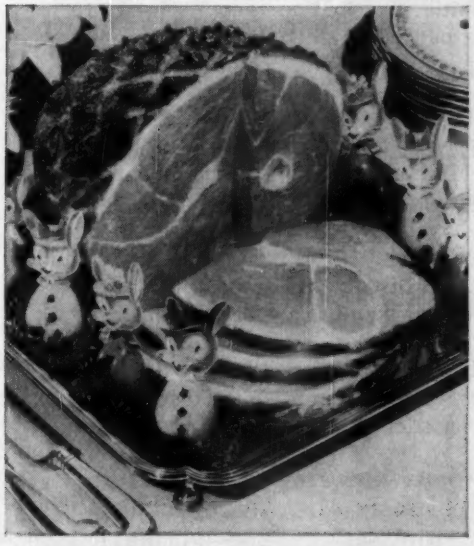
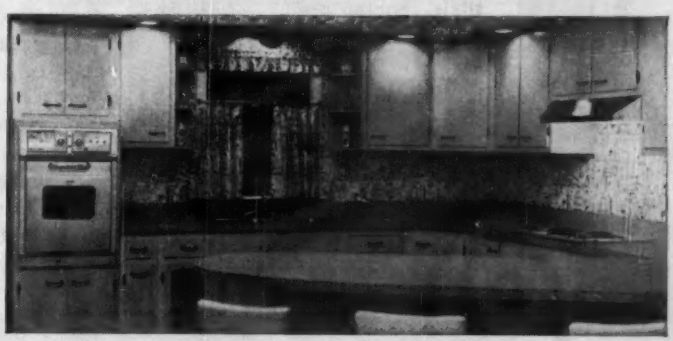
HOW *HERCULES* HELPS...

SET NEW STYLES IN PLASTICS—Diadem's new "Hairtainer," a multispring comb adaptable to any hair style, dramatizes the unique combination of resilience and rigidity offered by Pro-fax®, Hercules polypropylene, lightest of all plastics. Pro-fax is setting new standards for plastics where lightweight, exceptional heat resistance, chemical inertness, toughness and styling are essential.



ENHANCE COUNTRY-CURED FLAVOR IN HAMS—HVP®, Hercules hydrolyzed vegetable protein, is helping ham packers capture the elusive old-fashioned, slow-cured flavor in modern hams. Manufactured from nutritious wheat, HVP in liquid form can be easily added to regularly prepared cures to add a pleasant and distinctive flavor.



WORK WONDERS IN KITCHENS—The appearance of fine wooden kitchen cabinets is greatly enhanced by finishing them with nitrocellulose lacquer. Another reason why Henry M. Carr, Inc., Frankfort, Ind., applies a lacquer finish to birch cabinets such as these is to gain rapid air-dry. No baking equipment is needed to provide a tough, durable finish.

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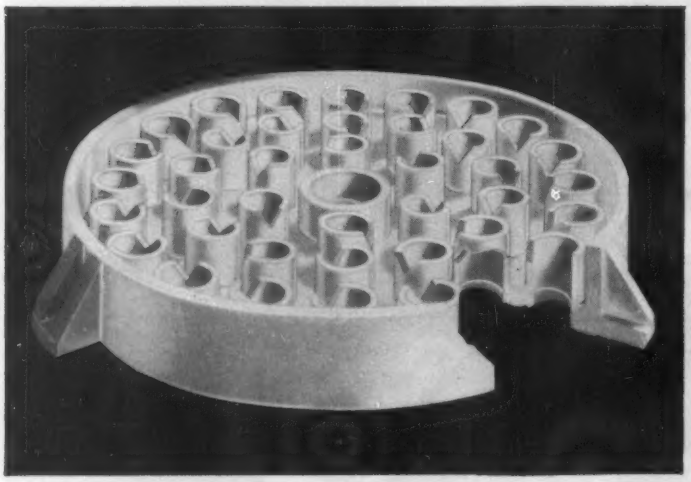
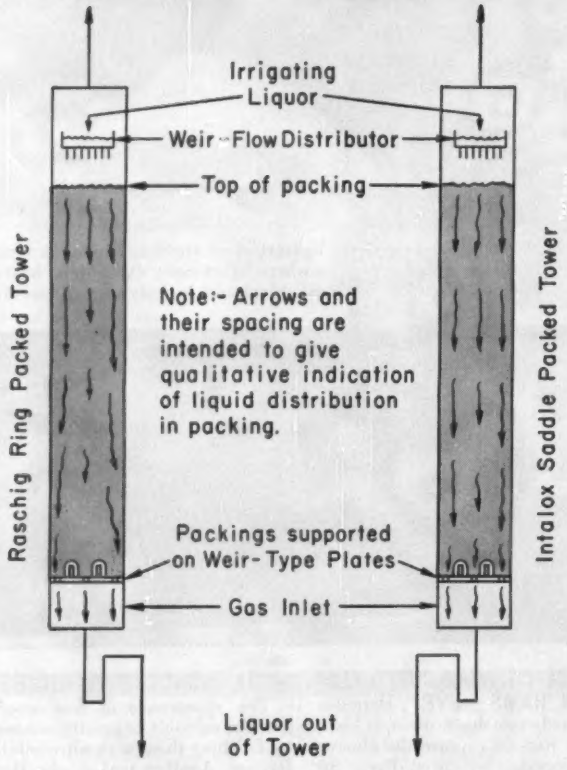
CHEMICAL MATERIALS FOR INDUSTRY

HERCULES

How to achieve better liquid distribution in PACKED COLUMNS





Full utilization of packing surface area in a column can only be realized if liquid distribution (both initially and throughout the bed) is such as to provide maximum *wetted* surface area.

The unique shape of the Intalox Saddle packing permits a thoroughly randomized arrangement of the packed bed, with a virtual absence of pattern packing. Thus, good initial distribution remains intact for greater packed heights than for columns of other packings, notably rings.

Now, U. S. Stoneware makes available two new types of tower distributors, each designed to take full advantage of the better internal distribution of Intalox Saddles. The "Multi-Level" is designed for low liquid rates; the "Weir-Flow"* for medium-to-high liquid rates. Both distributors assure infinitely better initial liquid distribution than the conventional types of distributors heretofore available. While designed for use with Intalox Saddles, they will improve the distribution characteristics of any packed bed.

** Made in chemical ceramics, carbon steel, or stainless.*

131-F

Full details in this NEW Bulletin

Bulletin TA-30 describes these new distributors. Gives data on packing support plates, how to install; when to re-distribute, and other data helpful to designers of packed columns. Free on request. Address Dept. CE 1158, U. S. Stoneware, Akron 9, O.

U. S. STONEWARE
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DEVELOPMENTS . . .

NOVEMBER 17, 1958

Chementator

C. H. CHILTON

Burning nitromethane in an internal combustion engine can double net power output, according to tests made at University of California. Preignition, actually an advantage in nitromethane-fueled diesels, can be eliminated from spark-ignition engines, it is believed.

New system of electrical insulation, composed entirely of inorganics, permits electrical equipment to run at red heat. Westinghouse has operated an experimental motor, sealed inside a 950 F. oven, for more than 100 hr. Object: improved electrical equipment for supersonic flight.

A New Jersey bakery boasts first commercial installation of Amflow process for continuous production of bread dough. American Machine & Foundry's new process combines conventional mixing, fermentation and makeup steps into one continuous, automatic operation.

New process reforms refinery gas

With excess refinery gas available from Shell and Caltex refineries at Pernis, Holland, the Municipal Gas Works of the Hague is contemplating a switchover from present gas-making processes, based on coal and coke, to a new thermal reforming process which can continuously convert refinery gas into city gas.

In thermal processing of refinery gas, carbon usually forms from the decomposition of olefins and aromatics. Hendrik Kempen, chief engineer at the gas works, claims to have found a way to thermally reform refinery gas without depositing any carbon in the reactor. This makes it possible, he says, to operate the process continuously instead of cyclically.

Kempen's invention can't be described in detail until patents are issued. His basic idea, however, is to pretreat the "reaction mixture" (possibly refinery gas plus a hydrogen-rich recycle) at 800-850 C. for approximately 0.5 sec. in order to convert higher hydrocarbons into methane and ethane. Then the gas mixture is brought to 1,200-1,400 C. and steam is added.

Test work has indicated that existing gas-works equipment can be adapted to reforming of refinery gas with savings in labor and maintenance costs and a capacity increase of 65%. However, pilot-plant work now under way, using entirely new equipment, may point the way to still better operating efficiencies.

Water-soluble resins give glossy films

Water-based paints in which the film-formers are in water solution, rather than in emulsion, were introduced at last month's Paint Industries Show in Cleveland. Amoco Chemicals and Archer-Daniels-Midland announced independent developments leading the way to greater use of water-based gloss architectural and automotive finishes.

Until recently, gloss finishes were not available in water-based systems. Last year, however, Celanese brought out a polyvinyl

Out of these ovens comes a new concept in American missiles

It's a black rubbery solid, known technically as cured polysulfide polymer and popularly, as solid rocket propellant.

Until recently America staked its missile and rocket program on liquid fuels.

But the Thiokol Chemical Corporation of Trenton, New Jersey, stuck by the unpopular theory that solid rocket fuel was not only feasible but actually more practical than liquid fuel.

The "unpopular" theory was tested and proved. Now, prospects are that the rockets of the future will be propelled into space by this black rubbery substance that a few short years ago was used only for making oil and gasoline hoses.

Already the 500-mile Pershing missile, the booster stage of the Army's Nike-Zeus anti-missile missile, and the Air Force Bomarc surface-to-air ramjet missile are slated for solid fuel. And in the offing is a solid-propelled ICBM.

In Thiokol's Marshall, Texas, plant these steam-heated Despatch Ovens cure a combination of propellant mix and liquid polymer to solid fuel inside the rocket engines. The ovens are also used to cure engine linings and to preheat cores before the casting operation.

You may not make missiles or missile components. Few of us do. But you may have a baking or curing operation similar to Thiokol's. Despatch is at your service with unmatched experience in the heat processing field—50 years and 50,000 installations.

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acetate latex said to produce a high-gloss finish, and Shawinigan Resins has just announced a comparable product. Reichhold, similarly, has come up with high-gloss, water-thinned alkyds.

On the other hand, advocates of solutions over latexes claim film integrity and gloss on a par with the best acrylic or alkyd solvent-base finishes. Absence of an emulsifier is said to be a definite asset.

ADM's new product is a water-soluble resin, called Arolon 1000, already in commercial production. Company will not identify its chemical composition, maintains that it is not acrylic, alkyd or melamine-modified alkyd.

The Amoco product is an alkyd made by cooking trimellitic anhydride with adipic acid and a glycol. Resulting resin, after adding pigment, is dissolved in ammoniacal water to make a water-system paint.

Amoco doesn't intend to get into the paint or resin business. Objective is to sell trimellitic anhydride, a potential product of the Scientific Design-Standard-Amoco process for oxidizing aromatics to polybasic acids. Amoco is now producing pilot-plant quantities of the anhydride at Whiting, Ind.

Diathermy seeks new chemical patients

Dielectric heating is headed for wider use in the chemical process industries. New Rochelle Tool Corp. (New Rochelle, N. Y.) reports that two of its dielectric rayon cake dryers are already in successful operation and seven more are under negotiation.

Because dielectric (radio-frequency) heating gives fast, uniform heating throughout a nonconducting solid, it is especially suited for materials which cannot conveniently be spread in thin layers and/or have poor thermal conductivities. Typical applications include curing of urea-resin wood glues, preheating of plastic preforms, curing and drying of cellulose sponges and foam rubber.

But moisture evaporation has not usually been considered an economic application for dielectric heating. Holding back use of dielectric dryers have been high capital cost of equipment and low energy efficiencies, as well as lack of practical know-how.

New Rochelle Tool hopes to break through these obstacles with its new Thermatool dielectric system. A typical, compact unit sells for about $140,000 and can dry 5 tons/day of rayon cakes. Consumption of 300-mc. energy is said to be only 0.5 kwh./lb. of water evaporated. This figures out to be an energy efficiency of 65%.

Since the rayon is in the dryer for only a few minutes, it can be subjected to temperatures as high as 265 F. with no damage. Exclusion of air assists in rapid drying and contributes to high thermal efficiency.

Pair of solvents beats three ions

Add vanadium to the roster of metals now being won via solvent (liquid-liquid) extraction. Because of its natural association with uranium, vanadium's recovery from uranium-vanadium ores by solvent extraction is a logical extension of the growing trend to solvent extraction for producing uranium itself.

Vanadium Corp. of America recently revamped its Durango, Colo., salt-roast plant to recover both uranium and vanadium by solvent extraction. VCA is using a combination solvent system, developed by the Bureau of Mines at Salt Lake City, which consists of an aliphatic amine and an alkyl phosphate in a solution of kerosene containing tributyl phosphate.

For recovery of uranium from ordinary sulfuric acid leach solutions, solvent is either an aliphatic amine or an alkyl phosphate. But neither solvent is well suited for vanadium recovery from acid-leach solutions in salt-roast plants because of the complications introduced by the presence of aluminum, ferric iron and chlorides.

The bureau found, however, that the two types of solvents used together gave much better results than when either one was used independently. An addition of 5% TBP made it possible to strip the extract with soda ash solution without formation of a troublesome third phase.

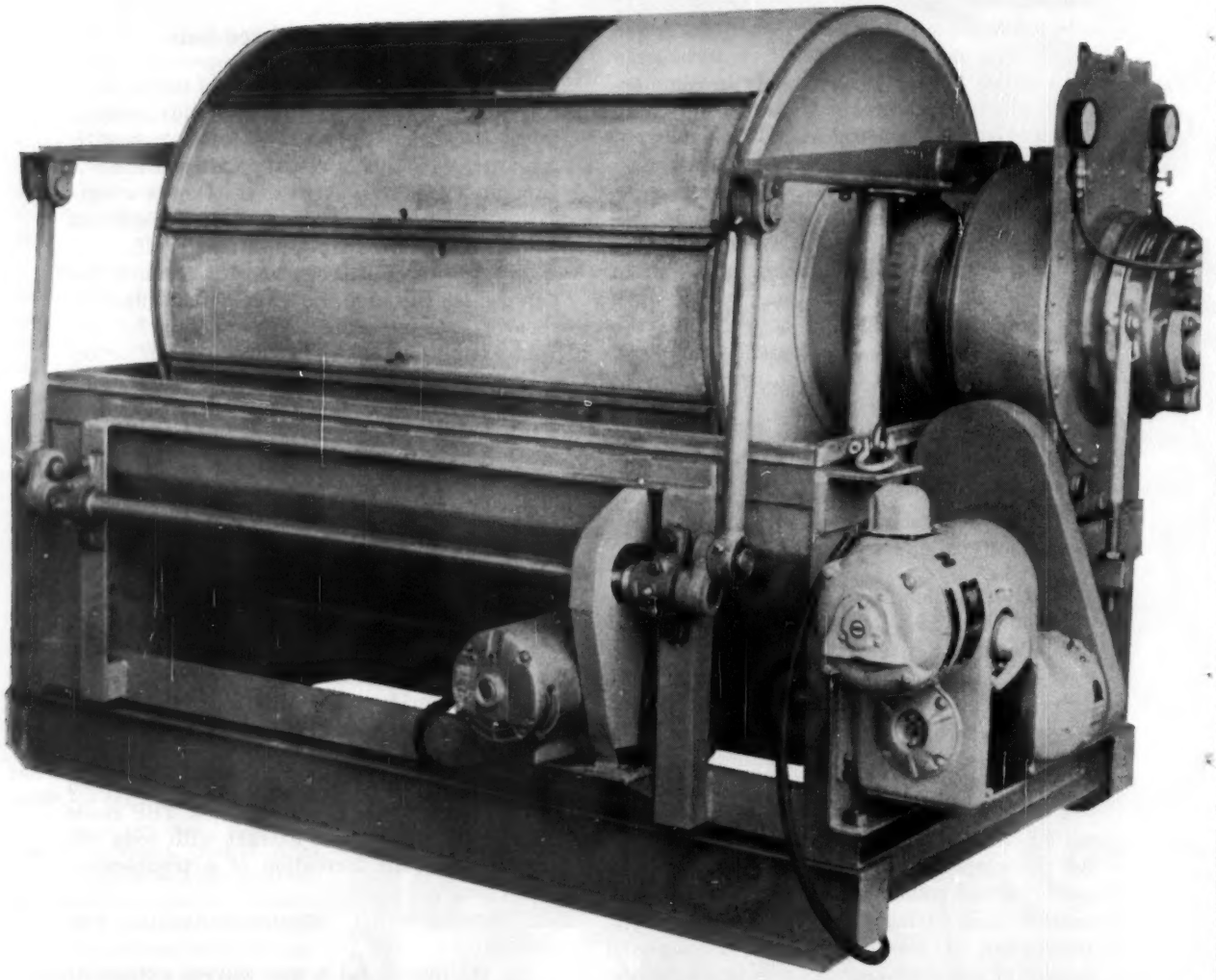
Among other uranium-vanadium producers:

• Union Carbide uses solvent extraction to recover vanadium at its Rifle, Colo., mill, but not at Uravan (there is no vanadium recovery at all at Maybell). Carbide uses either di-2-ethyl hexyl phosphoric acid or tri-*n*-octyl amine, does not use them in combination.

• Kerr-McGee, Shiprock, N. M., ran a vanadium recovery unit for some months, using DEHPA solvent, but declines to comment on the status of present operations.

(Continued on page 66)

FIRST



FROM DORR-

MOLDED PLASTIC ROTARY FILTER

developed for corrosive applications cuts cost • reduces scaling problems

NOW—for many corrosive applications which normally require alloy metal or rubber-covered construction—Dorr-Oliver presents a new and revolutionary rotary drum vacuum filter.

It's the first commercially successful filter available with all essential components fabricated of a wide variety of glass reinforced plastics. Plastic selected is dependent entirely upon application.

Plastic construction results in lower cost than rubber-covered or alloy metal machines of comparable size and design. Reduced weight means economies in structural requirements, rigging and transportation. Apart from corrosion-resistance, the plastic surfaces offer special advantages where scaling is a problem, thus cutting maintenance costs. Snap-out rubber drainage grids provide for easy inspection and replacement.

The new Dorr-Oliver plastic filter has already been thoroughly tested handling acid leach solutions in a large uranium mill. It is backed by the long experience of Dorr-Oliver in building all types of filters. Models are available with filtering areas from 9 to 100 sq. ft. and 3-ft. and 4-ft. diam. drums with faces from 1 to 8 ft. For more information, write to Dorr-Oliver Incorporated, Stamford, Connecticut.

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• Climax Uranium, Grand Junction, Colo., says that its particular vanadium recovery flowsheet would not benefit from use of solvent extraction. Only possible improvement, of little economic value, would be production of a vanadium concentrate lower in sodium content than the present sodium acid vanadate made by chemical precipitation.

Sand milling sweeps paint industry

A new way to grind pigments has wrought a virtual revolution in the paint industry during the past few years. It is a technique known as "sand grinding," invented by a Du Pont researcher.

Latest count shows about 100 sand mills in use at 11 Du Pont paint plants. These mills serve approximately one-half of Du Pont's pigment grinding needs. Practically every major paint manufacturer in the U. S. has taken out a license to use the sand mill. The process is most effective where extreme fineness of grind is required.

In sand milling, the pigment to be dispersed is agitated as a pigment-vehicle slurry with an approximately equal volume of 20-30 mesh Ottawa sand. This is done in a vertical cylindrical vessel provided with a vertical shaft carrying one or more flat-disk impellers. Sizes range from laboratory units to a 30-gal. production unit which stands 7-10 ft. high, is 2 ft. or so in diameter and is run at about 500 rpm. by a 30-hp. motor.

Continuous operation is obtained by feeding the vessel at the bottom and overflowing the dispersed pigment slurry at the top, retaining the sand by means of a screen at the outlet. Only small and infrequent additions of sand are required.

Du Pont engineers estimate that cost of a complete 30-gal. sand mill installation is only two-thirds that of a 6-ft. by 6-ft. pebble mill or a 5-ft. by 4-ft. ball mill and about half that of a high-speed three-roll mill. Yet this sand grinder turns out pigment paste two to four times faster than the other mills.

Du Pont is now working on applications of sand grinding in fields other than pigment dispersions. This work is still under wraps.

What type of kiln for carbon burning?

Fluid-bed revivification of granular activated carbon is now an accomplished fact at Corn Products' North Kansas City dextrose plant. A Dorr FluoSolids system has been in consistent, continuous operation there since August.

In switching from bone char to granular carbon decolorizing at its Pekin, Ill., plant, Corn Products replaced its vertical tube-type bone char kilns with two multiple-hearth Herreshoff kilns (*Chem. Eng.*, Sept. 1955, pp. 122-124). Object was to permit direct oxidation of nonvolatile impurities adsorbed on the carbon, as well as drive off volatiles.

However, the higher temperatures needed to do the job presented problems in operating control; you can't afford to oxidize much of the valuable carbon itself. A fluid-bed kiln seemed to offer the potential advantage of closer control, along with lower capital cost and low fuel consumption.

Since installation of the new kiln at North Kansas City nearly a year ago, CP engineers have discovered that, compared with regeneration of petroleum cracking catalyst, fluid-bed revivification of carbon is a tricky operation. Finding optimum operating conditions has been the subject of most of CP's development work this year.

For a similar job in a cane sugar refinery, meanwhile, Industrial Sugars, Inc., St. Louis, Mo., has swung over to a rotary kiln (*Chem. Eng.*, Mar. 10, 1958, pp. 80-82). For loads up to 10 tons/day of carbon, the rotary kiln is apparently the choice over fluid-bed and multiple-hearth kilns.

Oil-supported fluid bed for A-power

Newest design concept for a nuclear reactor is an organic-moderated, fluid-bed reactor, unveiled last month by Westinghouse. Now under study jointly by Westinghouse and the city of Burlington, Vt., this design may eventually be adopted for a 50,000-kw. electric plant at Burlington.

OMFBR will use BB-size uranium oxide pellets held within a large cylindrical container inside the reactor vessel. Through holes in the bottom of the container, a coolant-moderator, such as diesel oil, will flow upward through the bed of pellets, hydraulically expanding the bed in proportion to flow rate of the oil and thus controlling the chain reaction.

Westinghouse reports that an OMFBR would have low fabrication costs, excellent cycle time, fewer nuclear poisons, excellent shutdown characteristics. Further, it would not need costly, exotic construction materials.

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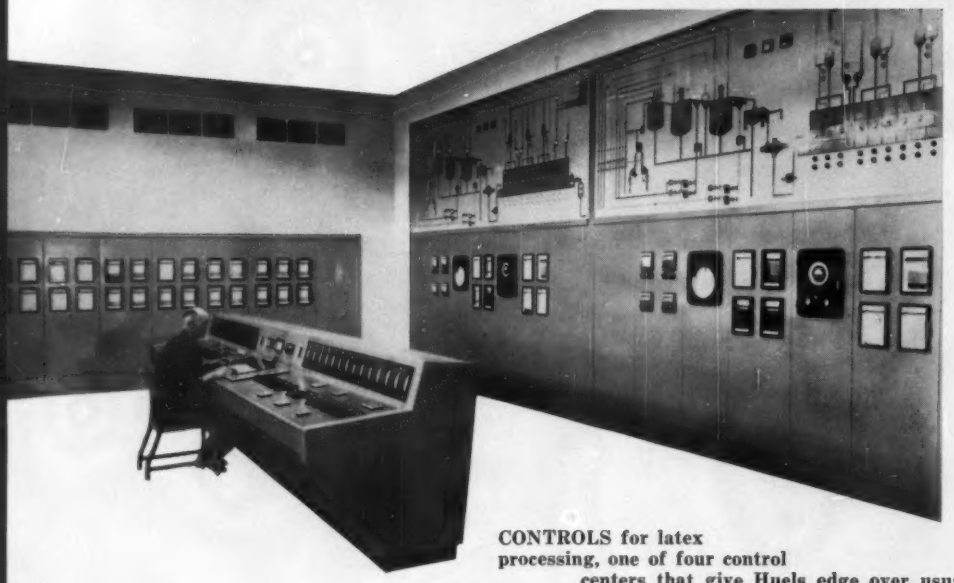


CONTROLS for latex processing, one of four control centers that give Huels edge over usual European practice.

U.S. Rubber Know-How Sprouts in Germany

Drawing heavily on technology developed in the United States, West Germany starts its first major postwar synthetic rubber plant.

Declared officially open in September, Bunawerke Huels' * new styrene-butadiene synthetic rubber (SBR) plant at Marl, West Germany adds another chapter to West Germany's story of postwar industrial recovery.

As the first major synthetic rubber installation built in Germany since World War II, Bunawerke's $27-million plant boasts a capacity of 70,000 long tons/yr., 39% of Germany's 1957 consumption. With minor equipment additions, Bunawerke can raise this capacity to the 90,000-ton/yr. level.

▶ **American Accent** — Plant incorporates a lot of U.S. engineering, but the Germans also added some original twists to suit their own process requirements.

Describing plant design, a Bunawerke official states, "This new cold-rubber plant bears no resemblance to old German warm-rubber plants and can be compared only with modern U.S. installations." (For latest in U.S. plants, see *Chem Eng.*, June 2, 1958, pp. 102-105).

▶ **All on One Site**—Bunawerke's plant is divided into four main sections: Butadiene production, butadiene purification, rubber polymerization and latex processing.

Butadiene plant uses Houdry Process Corp.'s butane dehydrogenation process fed by butane from nearby oil refineries. Butadiene purification plant uses copper-ammonium acetate (CAA) extraction process licensed from Esso Research.

Polymerization and latex processing were German-engineered, although firm has information-exchange agreement with Firestone on the polymerization process.

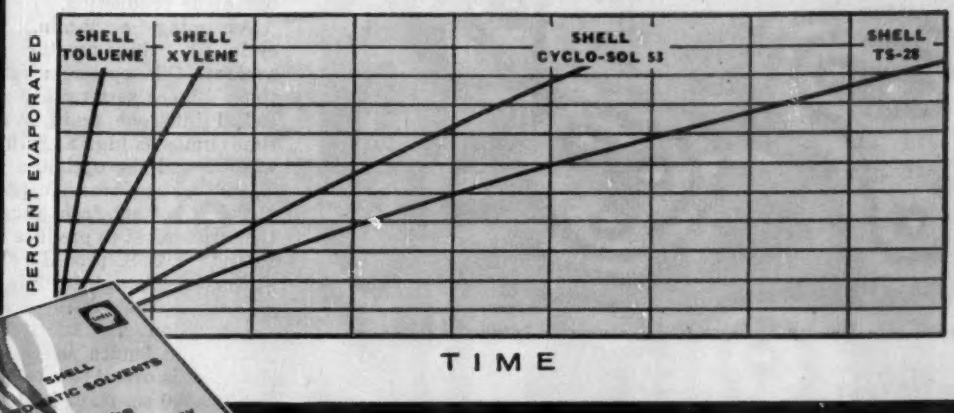
▶ **Heavy on Instruments** — Following the U.S. trend towards highly instrumented plants, Bunawerke's installation utilizes a whopping 2,078 control devices in the four central control rooms. Instruments with auxiliary fittings averaged $675 apiece, accounting for 10.5% of total equipment costs.

Firm says that it spent more on instruments than is common practice for other European chemical plants of comparable size, but feels that additional investment has paid off handsomely already.

Bunawerke uses a pneumatic (3-15 psi.) control system. At the time plans were drawn, there wasn't enough standardization to blend electrical instruments from different manufacturers into a single system.

* Owned 50% by Chemische Werke Huels and 16.7% each by Badische Anilin und Sodafabrik, Farbenfabriken Bayer and Farbwerke Hoechst.

For industrial finish formulation...



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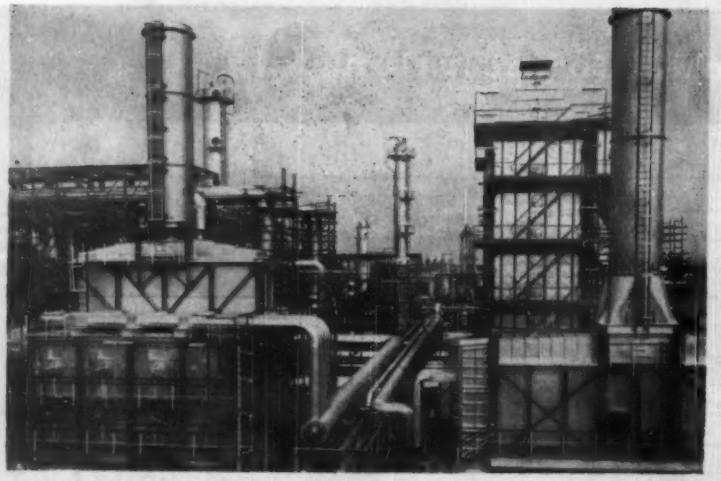


HEATERS hide Houdry reactors which convert n-butane to butadiene.

▶ **Picking Reactors**—Bunawerke bucked the trend toward big, 7,000-gal. polymerization reactors. Engineers picked 5,000-gal. reactors for these reasons: Fewer vessels and less steel are required for 5,000-gal. vessels than for the older 4,000-gal. variety. But in going to a bigger 7,000-gal. size, mixing and material handling become tricky. Too, when a 5,000-gal. vessel shuts down for repair, you lose less capacity than with bigger reactors.

There are 20 polymerization vessels, arranged in two parallel lines of 10 reactors each. Polymerization temperature is around 41 F. at 0-15 psig. Each reactor has paddle mixer and internal vertical tubes for ammonia cooling.

▶ **One-Piece Construction** — Polymerization reactors in most American SBR plants are glass-lined with bolted heads.

Bunawerke, however, went over to one-piece welded stainless-steel reactors to simplify construction and hold leaks to a minimum. Internal cooling tubes also are welded in place to prevent ammonia from seeping into reaction mixture.

Engineers aren't worried about getting inside these welded vessels for servicing. Should trouble develop, mobile crane will lift out entire reactor and take it to maintenance shop where top can be cut out. Bunawerke believes construction and operational savings will offset added costs of this involved maintenance procedure.

▶ **Optimizing Dehydrogenation** —Usually a Houdry butane dehydrogenation unit consists of five or seven reactors hooked in series (*Chem. Eng.*, Oct. 1957, p. 225). Bunawerke employs, instead, six reactors grouped in two parallel strings of three reactors each.

Firm cites two reasons for this arrangement: First, only half of the reactors are out of operation when catalyst is replaced; the other three reactors can operate above capacity during this period. Second, 4-min. reaction time is optimum for butadiene production.

Assuming a 2-min. purge cycle, a three-reactor train achieves this optimum reaction time. Where seven reactors are linked into one train, reaction time climbs as high as 9-10 min., way beyond the optimum point.

Another switch: Instead of utilizing hot air from regeneration of catalyst to produce steam (standard U. S. procedure), hot air passes through two giant air preheaters that raise incoming regeneration air to 1,000 F. Total tube length in these exchangers is over 114 mi., providing 280,000 sq. ft. of heat transfer surface.

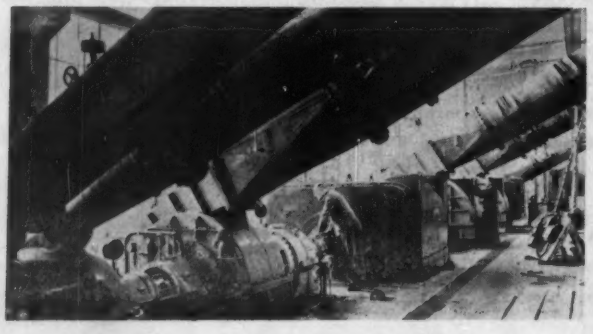
▶ **Process Outline** — Purified butadiene from the CAA unit is mixed with styrene from Chemische Werke Huels adjacent plant. Emulsifier and an activator (tetra-calcium-pyrosulfate with iron sulfate) is added and mixture is pumped to polymerization reactors.

For top-quality latex, reaction is stopped after 60% polymerization. Unreacted styrene is steam distilled from the latex; excess butadiene vapor is compressed to liquid and recycled.

After addition of antioxidant in stirred tanks, latex goes to continuous coagulation step where dilute sulfuric acid coagulates latex to rubber crumb. Particles of crumb are washed, drained on shaker screens and dewatered mechanically in worm gear presses.

Compressed air transports crumb to three 100-ft. steam-heated conveyor dryers. Finally, dried rubber is pressed into 55-lb. bales for packaging and shipping.

COMPRESSORS evacuate Houdry reactors, feed purifiers.



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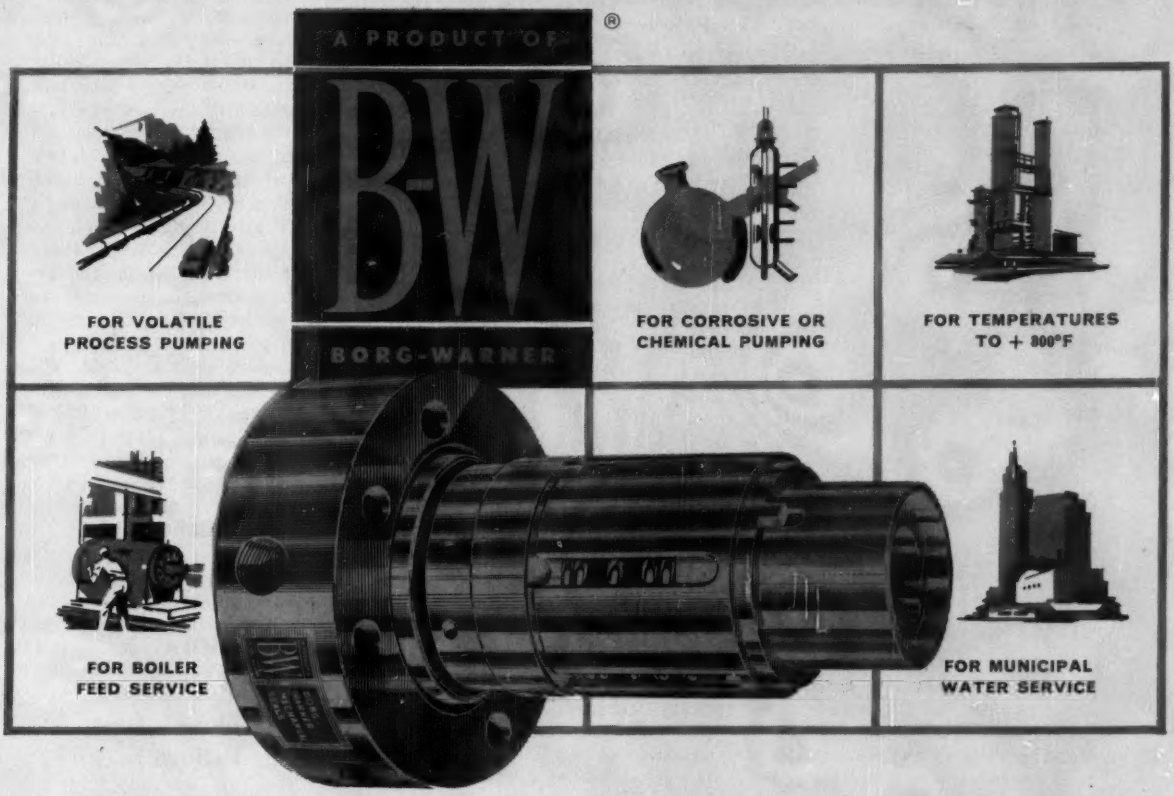
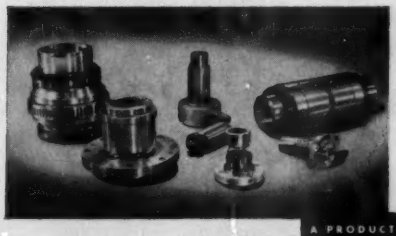


Precision shaft seals for all makes and models of centrifugal pumps...and other rotating shaft sealing applications



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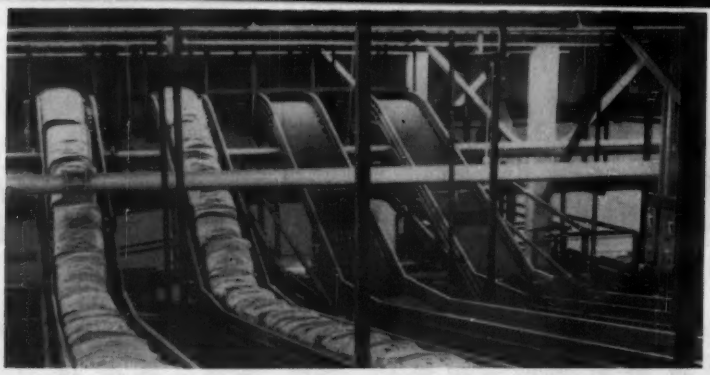


FILLED bags from trunk conveyor flow onto appropriate accumulator lines (above) under operator direction. When accumulator inventory exceeds one pallet load, line feeds into pallet loader seen discharging (below).

Sugar Maker Mechanizes Loading Job

To load 600,000 tons/yr. of various types of sugar packages onto pallets for shipment, the California and Hawaiian Sugar Refining Corp., Crockett, Calif. now operates a mechanical palletization facility believed to be the largest and most comprehensive in the U. S. A.

Each 24-hr. day, the C&H facility palletizes about 120,000 production units that fall into three general categories:

- Shipping cases containing cartons of various types of sugar.
- Paper bales enclosing from six to 30 paper packets of granulated sugar.
- Various types of sugar bulk-packed in 25-, 50- and 100-lb. bags.

▶ **Pioneers on Bags**—In setting up this installation, C&H engineers and pallet-loading specialists from Lamson Corp., Syracuse, N. Y. actually pioneered mechanical palletization of 25-, 50- and 100-lb. bags. Although many industries palletize cases, C&H is the first company to combine mechanical sorting and accumulating of bag packages with automatic pallet loading.

People at C&H also believe that they are the first organization to handle so many different types of packages and loaded pallets over one system.

Large 60-in. x 44-in. pallets weigh up to 4,500 lb. loaded, led Lamson engineers to design special large pallet loaders for this installation.

▶ **Much Smoother Operation** — Obvious economies from improved materials handling by new system are not the only gains. C&H reports that it has reduced damage to sugar packages considerably. Too, pallet loads are more uniform and better balanced, permitting improved stacking and utilization of storage space. Production can be scheduled easier and with greater flexibility.

On the other hand, C&H incurs substantially greater charges to maintain the complete mechanical and electrical equipment. But, substitution of higher maintenance skills for previous manual labor reduces attendant risks and employee relations problems.

▶ **The System**—Route of bagged sugar through system illustrates how it works. Sugar in 50- and 100-lb. bags passes through a sorting station enroute to pallet loaders; 25-lb. bags bypass sorter. As each bag passes operator, he pushes selector button that will automatically transfer bag from main trunk conveyor to branch conveyor accumulating that type package.

There are 10 lines which accumulate bags ahead of three pallet loaders. When a line accumulates enough packages to form a pallet load, it delivers the bags to preselected loader.

As packages flow into the loader, a rotating pin and a ram form the units into interlocked layers. A stripper plate then retracts to drop the formed layer onto the pallet a few inches below. Action repeats for successive layers until pallet is full.

Five other loaders handle bales and cases. All eight loaders discharge loaded pallets onto a common conveyor which delivers the pallets to any of four points for pickup by fork truck.

Early Evidence Hints at Bearing Failure in Fire

Although by no means conclusive, meager early evidence in the recent fire in the compressor house of Esso's Baton Rouge, La., ethylene plant, hints at bearing failure on one of the load compressors as cause of fire which damaged two gas turbines. Combustion-gas turbines, manufactured by General Electric, had been on stream several months.

According to GE, damage seems to be largely on the surface and will probably need little if any machine work for repair. Earlier rumored estimates of six to nine months for repair now seem way too pessimistic.

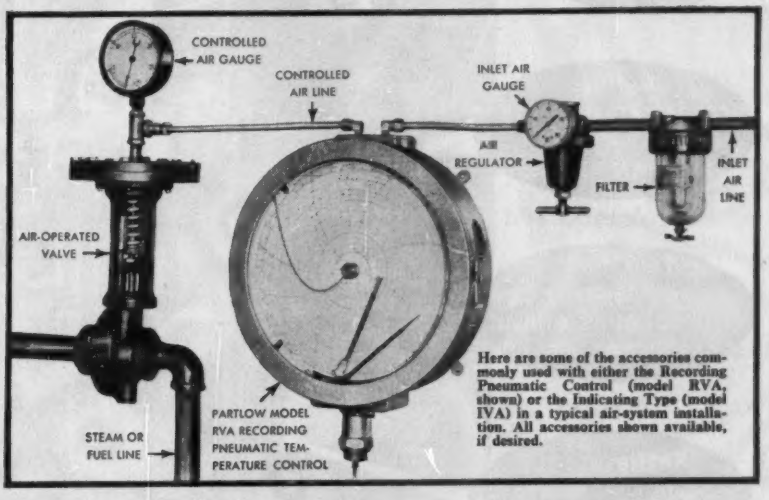
Esso can still deliver high-purity ethylene from its 40-60 days underground supply and is operating lower-purity ethylene unit.

Introducing . . .

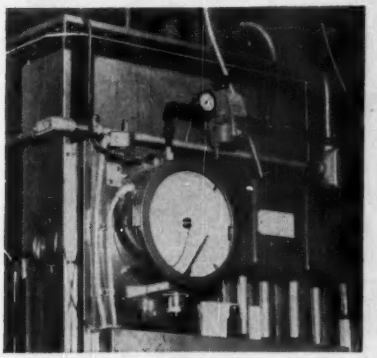
the NEW Partlow Pneumatic Control

New from Partlow . . . throttling-type pneumatic controls engineered to function with extreme accuracy, and sensitivity, under virtually *any* operating conditions.

Actuated as they are by the powerful, direct action of mercury, the Partlow pneumatics actually contain *fewer parts than any other pneumatic control on the market* . . . one reason why they're . . . . **Simpler to install • Simpler to maintain • Simpler to operate • Simpler to replace • and longer lasting, too.**

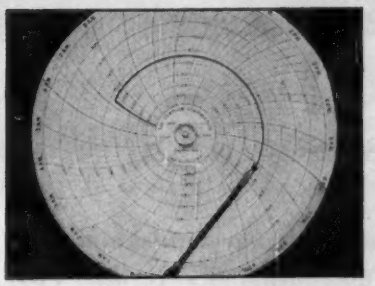


Here are some of the accessories commonly used with either the Recording Pneumatic Control (model RVA, shown) or the Indicating Type (model IVA) in a typical air-system installation. All accessories shown available, if desired.



MODEL RVA

Pneumatic Recording control, installed on new steam-heated cross-flow dryer built by Lydon Bros., Hackensack, N. J.



INSTANT RESPONSE

to temperature changes is a key feature of the Partlow pneumatic. Built-in bulb sensitivity teamed with advanced mechanism design means a minimum of saw-toothing on start-up and a fine line of control when the instrument has reached its throttling equilibrium.

OUTSTANDING FOR ACCURACY, SENSITIVITY AND FLEXIBILITY

The new Partlow pneumatic controls are accurate to within 1% of scale in any one of 10 ranges from –30° to 1100°F. *Exceptionally sensitive too* . . . providing positive, hair-trigger response even to fractional changes in temperature. *And flexible* . . . with throttling range adjustable anywhere from 3 to 20% of scale range.

COST LESS TO OWN AND OPERATE . . CUT "DOWN TIME" TO A MINIMUM!

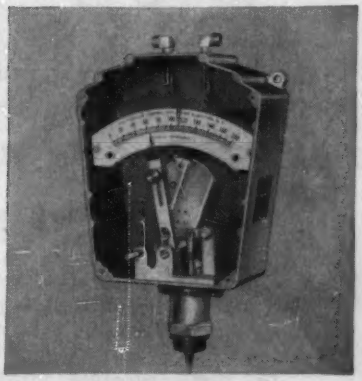
Because they contain fewer parts, Partlow pneumatic controls cost less to buy: next to nothing to operate and maintain. *All elements of the same range are interchangeable,* which means they can be replaced right on the job instead of back in the factory . . . 'Down time' is reduced to a matter of minutes. And no expensive inventory of spare parts or spare instruments is ever required.

IDEAL FOR HAZARDOUS OR 'SHOCK' LOCATIONS!

There are no delicate electronic tubes or gadgets in the Partlow pneumatic to get out of kilter, or possibly trigger an explosion. Its ruggedly simple internal mechanism is virtually shock-and vibration-proof . . provides maximum resistance to moisture, fumes, acid and all types of corrosion. Long-life and trouble-free performance are hallmarks of the pneumatics, as they are of all Partlow controls.

EXCEPTIONALLY VERSATILE TOO!

Both pneumatics — the Recording and the Indicating models — can be used in systems regulating the flow of steam, water or gas . . . or controlling other air-operated devices. Whatever the nature of the heating appliance it actuates, the chances are there's a Partlow pneumatic control to fit your requirements dependably . . . economically . . . *precisely.*



MODEL IVA (interior view)

New Partlow Pneumatic Indicating Control, with throttling range adjustable from 3 to 20%.

SEND US YOUR SPECIFICATIONS

Ask today for a control recommendation tailored for your specific requirements. Of course, if desired, you may field-test this superb new control without cost or obligation. For details write, wire or phone Dept. E-1158.

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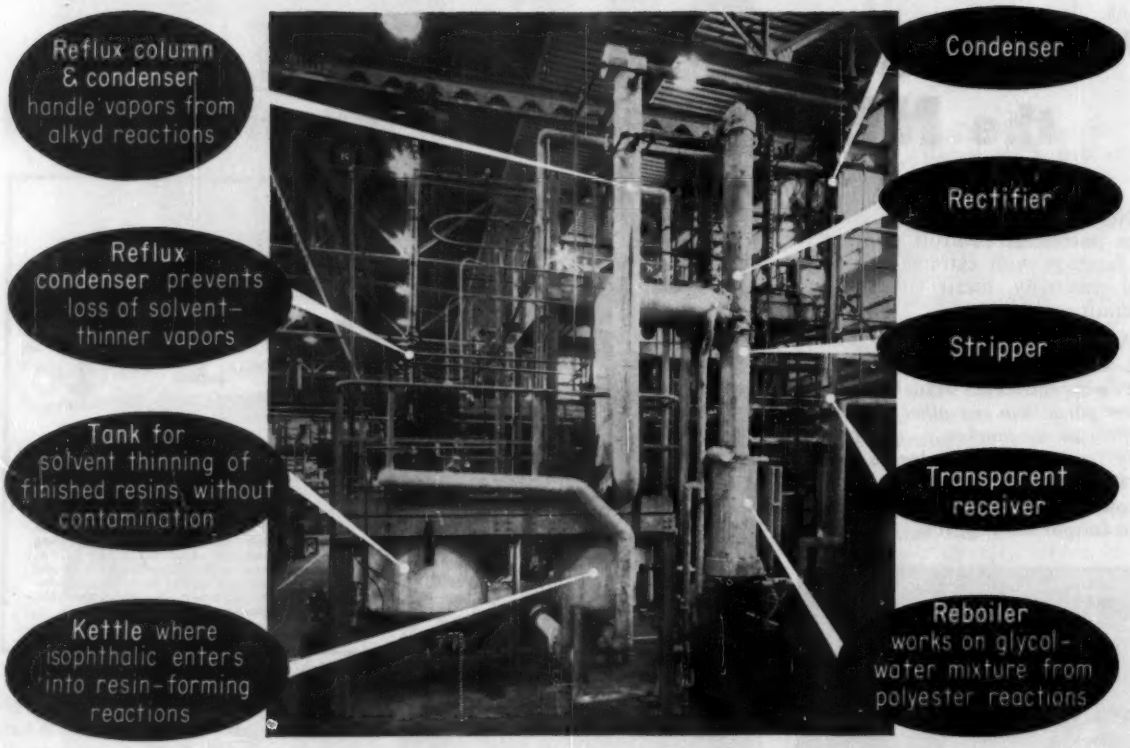

Piloting Sparks Isophthalic's Market Drive

Here is the pilot unit set up to develop isophthalic's full potential for improving customer's resins. First entry for house paint use raised sales 57%.

A recently established California Research Corp.* pilot plant is fast becoming a valuable proving ground for manufacturers interested in isophthalic-based alkyd and polyester resins.

In effect, at this proving ground serious manufacturers can study variables affecting their specific problems in processing esterification products of isophthalic. And the technical knowledge gained in studies improves isophthalic's position.

▶ **Key Role in New Paint** — When W. P. Fuller & Co., San Francisco, decided to shore up a sagging alkyd-base paint market, it turned to CalResearch's pilot plant for help in formulating an isophthalic-based alkyd resin for use in the vehicle of a completely new paint line.

Early this year, Fuller culminated its development by introducing a new exterior paint incorporating the new alkyd resin. To date, the new formula has boosted sales of Fuller's exterior line 57% over a comparable period of the previous year.

While granting full credit to isophthalic's major contribution to this success, both Fuller and isophthalic-marketing Oronite Chemical Co.** attest that CalResearch's unique pilot plant shares major credit, also, in launching this pioneering product.

▶ **Tailors Resin to Need**—Laid out to exploit fully isophthalic's potential, the CalResearch facility combines the utility of small-scale processing with versatility that can duplicate almost any commercial alkyd or polyester resin line. According to W. T. Bailey, chief engineer of the unit, probably no other alkyd resin pilot plant incorporates as many features.

Design of unit makes possible the use of reactants that normally could not be handled, permits running reactions faster with minimum loss of solvent. Included in the plant are a Dowtherm heating system, two flexible overhead distillation units, a separate solvent thinning vessel and variable-speed agitators.

▶ **Runs Hotter**—With auxiliary heaters, Dowtherm unit will deliver up to 200,000 Btu./hr. to maintain 50-gal. resin kettle and other parts of system at temperatures up to 600 F. This is hotter than usual temperature for most resin units heated directly by electricity, gas or oil. But isophthalic-based resins can be processed at higher temperatures (525-575 F.) than phthalic anhydride-based resins (450-475 F.).

In addition to heating the reactants, Dowtherm can be pumped to the jacketed distilla-

* Research subsidiary, Standard Oil Co. of Calif.

** Chemicals marketing subsidiary, Standard Oil Co. of Calif.

tion-column feed line and to jackets for the column's rectifier-stripper sections (note picture).

▶**Heat for Overhead**—But Dowtherm is not the only heating medium used in the resin plant. Overhead, the distillation system relies on some other heating features.

Three-way valves above the resin kettle and ahead of the overhead condenser regulate which of two units will be used. In one, vapors pass through a steam-traced reflux column and a steam- or boiling water-heated tube bundle. They're condensed in the water-cooled overhead condenser and collected in a Pyrex-brand receiver.

In the second unit, vapors pass through the Dowtherm-jacketed line and feed to a packed distillation column. There, the rectifier section can be used alone, by blinding off stripper and reboiler, or with rest of column.

Steam or boiling water, as well as Dowtherm, can heat the rectifier-stripper section. Steam at 700 psi. and 500 F. heats the reboiler. Using either setup, bottoms products return to resin kettle, while overhead vapors condense and collect in the Pyrex-brand receiver.

By observing flow rate of product into this receiver, operator can control reaction better than he could with a non-transparent receptacle. All control of unit is manual but automatic recorders keep temperature and agitation-speed histories.

▶**Why Boiling Water** — CalResearch also feels that its unique use of boiling water rather than steam is a processing advantage, in some cases, because it is more effective in controlling loss of volatiles.

Suppose for example that vapor from resin kettle is mixture of glycol and water. During distillation, column discharges water vapor overhead and returns glycol bottoms to resin kettle. If temperature of column is controlled by steam, it may not be able to handle a surge of entering vapor without allowing some non-condensed glycol vapors to pass through and be lost with water vapor discharging overhead.

On the other hand, with temperature controlled by boiling water, there is sufficient heat capacity to cool the glycol to condensation point, while still assuring that water of reaction is distilled off.

▶**Hold Purity While Thinning**—It's not necessary to add solvents to all batches, yet many formulations require them. A 100-gal. thinning tank simulates normal commercial practice, a rare example of such practice on a pilot scale where material generally is thinned right in the reaction vessel. Result is a purer product than when resin is thinned in reaction vessel, where deposited contaminants might be washed into resin.

Finished products can be pumped from 50-gal. resin kettle to thinning tank through a steam-traced line. A reflux condenser, heated with steam or cooled with water, returns solvent vapors back to thinning tank.

▶**Ranges of Agitator Speeds**—In a typical resin pilot unit, agitation is fixed at one or two speeds. CalResearch's plant offers variable-speed turbine agitation up to 600 rpm. on resin kettle and up to 220 rpm. on thinning tank.

With this type of speed control CalResearch engineers can duplicate client's mixing conditions and process many more resins than possible with fixed speed.

Kettle agitator also has significantly higher maximum speed than most resin units—600 rpm. (1,400 ft./min. agitator blade-tip speed) as compared with 250 rpm. in usual practice. This extra speed, backed up by sufficient power, has permitted plant to handle esterification products with viscosities as high as 10,000 centipoises—about that of corn sirup at room temperature.

▶**The Finishing Touch** — Care taken by CalResearch men to assure top quality shows up in an item such as the glycerol trap on the feed line for the distillation column. This trap prevents air from entering the system, especially during a cooling stage. Thereby, chance for oxidation and discoloration of resin is avoided.

Atomic Waste Hazard Cut By Fluid-Bed Calcining

Atomic Energy Commission is erecting a $6-million pilot plant at its Idaho Falls, Idaho, National Reactor Testing Station for calcining highly radioactive waste liquids from fuel element reprocessing. Fluidized-bed calcining system will reduce liquid to safer—and easily stored—solids occupying only one-seventh the volume of the liquid.

Fluor Corp. is engineering and building the 1-gal./min. calcination system on a $3.4-million contract from AEC. Process was originally developed by Argonne National Laboratories and Phillips Petroleum; Fluor did final engineering and drafting. Project is scheduled for completion by February 1960.

Calcined solids will be stored in a nearby concrete storage vault. Present practice is to store waste liquids in cooled stainless steel tanks underground. In addition to the increased safety of solids storage, process is expected to be economically competitive with liquid storage system.

Petrochemicals Spurt Boosts Japan's Economy

Close cooperation between six Japanese chemical firms is bringing Japan into a position of world prominence in field of petrochemicals. Japan already ranks as fourth largest plastics producing country, behind the U. S., England and Germany.

Now getting under way is a $70-million petrochemical manufacturing center between Yokohama and Tokyo that will further boost that country's $2-billion annual plastics sales. Project was drafted by government planners and combines the resources of six of Japan's chemical giants.

Mitsui Petrochemical Co., already an ethylene producer, has started work on a 12,000-metric-ton/yr. Ziegler polyethylene unit. Mitsubishi Petrochemical Co. will bring a 10,000-ton/yr. polyethylene plant on stream soon.

Early in 1959, Japan Petrochemical Co. is slated to bring

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FREEPORT SULPHUR COMPANY

25,000 tons/yr. of ethylene capacity on stream along with a 5,000-ton/yr. butadiene facility. Styrene monomer will be produced in a plant under construction by Ashai-Dow, an affiliate of Dow Chemical Co. Bulk of monomer will go into firm's own polystyrene plant; rest will be sold to synthetic rubber producers.

Standard Oil of Indiana is cooperating with Furukawa Chemical Industries on a 9,000-ton/yr. polyethylene unit while Showa Yuka holds a Phillips license for production of high-density polyethylene.

Monsanto Chemical Co. was an early-bird on the Japanese plastics scene: Mitsubishi-Monsanto produces both polyvinyl chloride and polystyrene resins. At a plant in Nagoya, Monsanto turns out PVC compounds, films and plasticizers.

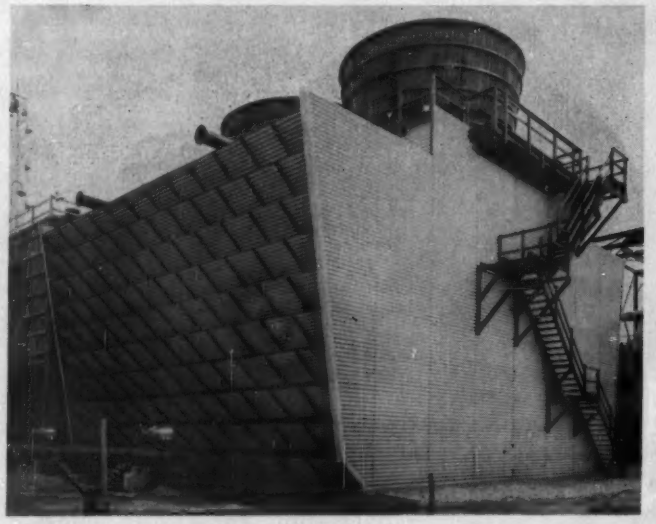
Ethylene, Too, Can Be Stored in Salt Domes

Vacant salt domes, long used to store propane and butane, can now be safely used for storing large amounts of ethylene—extending storage economies to this more active gas. So says Gulf Oil Co. in a paper given at the recent Salt Lake City meeting of the American Institute of Chemical Engineers.

Gulf makes ethylene at its Port Arthur, Tex., refinery at a 1-million-lb./day clip and distributes it to Gulf Coast customers through a 147-mi. pipeline. Gulf stores more than 30 million lb. underground to allow for fluctuations in production and customer demand.

Storage cavities, formed by leaching salt formations, are vertical pencil-shaped holes, 1,000 ft. deep and up to 80 ft. dia. Located deep within a solid bed of salt, cavities hold ethylene at 1,500-2,000 psi. with virtually no leakage. Gas is stored over brine and so picks up some water that must be adsorbed before ethylene is pipelined.

Esso also stores ethylene produced at its Baton Rouge, La., refinery in salt domes. Firm's 40-60 days' underground backlog was vitally needed when its new ethylene plant was shut down by fire in early October.



Slanted Cooling Tower Designed to Thwart Icing

Esso's Baton Rouge, La., refinery is trying out a new cooling tower design originated by the Marley Co., Kansas City, Mo. Tower, 30 ft. high, slants 8 ft. inward so that there is less cooling surface at the bottom where water is coldest and ice tends to form in cold weather. Too, asbestos cement louvers are spaced on 3-ft. centers—six times usual spacing—so that louver openings can't be plugged so easily by wintertime freezing.

NEWS BRIEFS

Auto exhaust control: Air Pollution Foundation, San Marino, Calif., is now engaged in preliminary testing of three devices to control automobile exhaust: a direct-flame afterburner which operates fully in deceleration, idle, acceleration and cruise; a catalytic afterburner—in early development stage—which reduces nitric oxide content of exhaust; a catalytic afterburner, aimed at reducing hydrocarbons, which has been used for 6,000 mi. on a car using leaded gasoline.

Nuclear fusion: Munich Technical University's researchers revealed at a meeting of the Bavarian Physical Society in Wuerzburg that they have detected what they believe to be neutrons from nuclear fusion at 4 million deg. K. in an 8-in.-dia. by 20-in. deuterium-filled straight tube. A 40-microfarad battery of condensers supplied several hundred thousand amperes to produce a pinch effect on discharge; neutron emission was about 10^7 neutrons per discharge.

Sahara Pipeline: French-Government controlled oil companies operating in the Sahara have contracted Bechtel Corp. to construct a 475-mi. pipeline from Edjele area in Algeria, near the Libyan border, to the Tunisian port of Gabes. Pipeline, due for completion in 1960, should be carrying 5 million tons/yr. of oil the following year and over 14 million tons/yr. when four pumping stations are finished.

Chemical Overcapacity: Causes and Cures

Most of today's unused chemical capacity is a byproduct of the industry's technological vigor. Look for this same vigor to provide the cure.

Today's chemical overcapacity is the penalty of success. Sure, errors in judgment had a hand. But you can "blame" most of it on chemical companies' knack for impressing obsolescence on products and processes—their own as well as their competitors'.

With a bit of help from the rest of the economy, the same technical vitality will make short work of unused capacity.

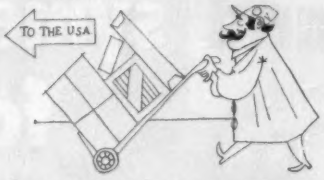
This is the theme running strongly through a story, in Stanford Research Institute's chemical economics newsletter, on chemical overcapacity.* Here's SRI's checklist of causes, preventions and cures:

Overcapacity: What Causes It

A New Process—Petroleum-based ethyl alcohol, as it pushes fermentation alcohol out of more markets, idles production capacity for the latter.

Troublesome Coproducts — There may be, in the production of chemicals in great demand, accompanying products without a comparable market. A classic example is the chronic overcapacity of caustic soda, a coproduct of chlorine.

Imports—Although our favorable balance of trade helps overall chemical capacity utilization, imports of certain chemicals causes capacity to hang heavy on the hands of domestic producers.



A Modified Process—Process improvements increased Union Carbide's ethylene oxide capacity to the point where the company deferred construction of new plants.

Upgrading a Chemical — If producers with idle ammonia capacity decide to upgrade their product to urea, existing manufacturers of urea may suffer from overcapacity.

Identical Company Competition—Two companies may decide to build similar chemical plants in same area. Neither of two tetraethyl lead plants on the West Coast is warranted from the standpoint of national capacity. But when refiners there offer to do all their buying from a local TEL plant both Du Pont and Ethyl felt they had to jump in with new plants.

Nonchemical Company Competition—As a growth industry, the chemical industry attracts outsiders seeking to diversify into areas like ammonia and plastics.

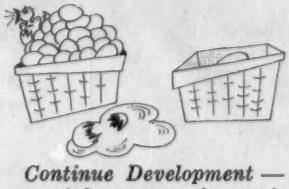
Misjudgment of Market Potential — Titanium market researchers didn't anticipate the fabrication difficulties and changes in military procurement that cropped up.

Wartime Demand — World War II requirements for toluene were too much for coke-oven sources. Petroleum refiners got in the field and stayed there after the war was over.

Overlapping Products—New capacity for a chemical similar in performance to an older chemical (in the same company, sometimes) often leads to overcapacity in the latter. Rayon-nylon rivalry is an example.

Overcapacity: How to Avoid It

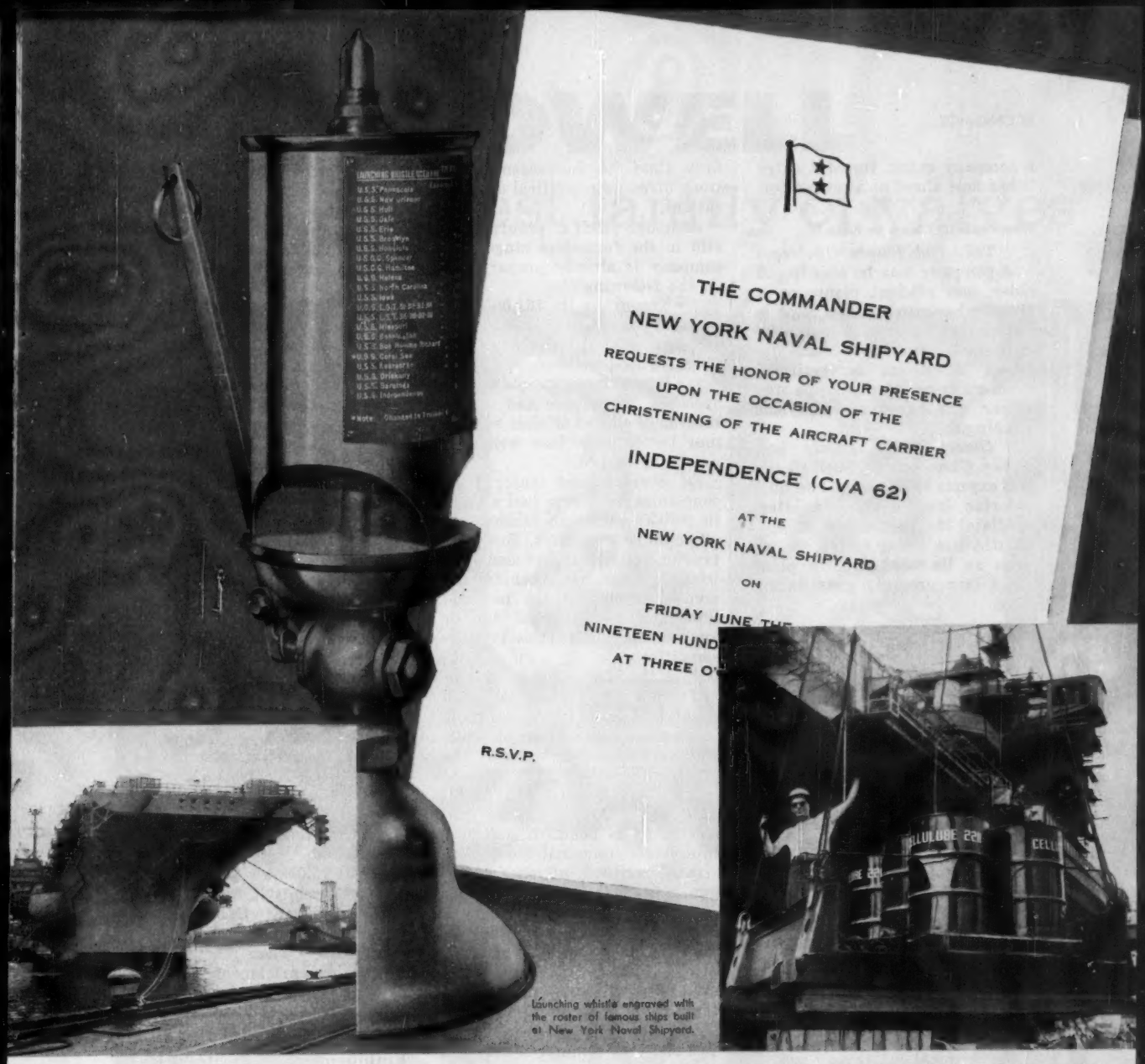
Avoid Concentration — It's dangerous to concentrate in a single field, however attractive, without patents or other protection.



Continue Development — A company's best protection against obsolescence from improved competitive products is to develop the improved products first itself. Du Pont, with its fibers, and Procter & Gamble, with its detergents, play this role to a fare-three-well.

Speed New Plant — Market and technical research and developent, readily available capital resources, and engineering and construction capabilities give

* Stanford Research makes a nice distinction between "excess" capacity and "superfluous" capacity. "In a growth industry such as chemicals some excess capacity is necessary and desirable." Since it takes two years to build a chemical plant and bring it up to normal activity, the capacity of a plant today should be able to meet expected demand in the third year hence, says the report. "Capacity over and above this amount can be termed as 'superfluous' capacity."



Launching whistle engraved with the roster of famous ships built at New York Naval Shipyard.

The U.S.S. Independence, newest Navy super carrier, recently christened and soon to be commissioned.

Fifty-five gallon drums of Cellulube 220 . . . part of a six-car trainload . . . being put aboard the new Independence. These hydraulic fluids will operate deck-edge elevators between hangar and flight decks.

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Cellulubes increase the Navy's fire-resistance power

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All the great carriers on that roster . . . and all ships of the Navy's Carrier Fleet . . . carry Cellulubes in the hydraulic systems of their deck-edge elevators. And on the Navy's mighty missile ships, atomic-powered submarines, and destroyers, these functional fluids are doing their fire-safe hydraulic duty.

Industry, too, uses Cellulubes . . . for power transfer and lubrication where flame- and explosion-resistance, excellent lubricity, and unchanging viscosity are important. Cellulubes are available in six controlled viscosities, one of which is best suited to your particular operations and the safety of your plant. For evaluation samples, please let us know the application involved.

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Overcapacity: How to Ease It

Take Old Plants Offstream —A company may be able to put older, less efficient plants on a standby basis and still serve present market needs with newer facilities. American Cyanamid closed down its acrylonitrile-from-ethylene plant, keeps the newer one based on acetylene running.

Divert Extra Plants into Other Chemicals — Shell Chemical expects to be able to run allyl chloride (now a glycerin intermediate) to production of epichlorhydrin, epoxy resins, etc., as soon as its new glycerin plant (and new process) gets underway.

Of course, excess capacity throughout the industry will tend to cure itself in time as chemical markets continue to grow. The pressure from without may ease, too, if, as is likely, nonchemical firms feel less inclined to give our industry a whirl in the face of increasing competition and technology change. Experienced chemical companies have the facilities and hard-won know-how to keep pace with technological change—something which part-time chemical outfits may lack.

More Politics For Chemical People?

"Whether we want to be there or not, Gulf and every other American corporation is . . . up to its ears in politics, and we must either start swimming or drown."

These are the words of Archie D. Gray, senior vice-president of Gulf Oil Corp., as he writes in a company magazine. They mean that at least one chemical process company is in the forefront of industry's newly avowed determination to "get into politics." (U. S. Chamber of Commerce recently appealed, for the first time, to businessmen to work directly in political organizations.)

Although Gulf's program is still in the formative stage, the company is already prepared to do the following:

- Encourage its 161,000 employees, stockholders and dealers to take a more active role in their neighborhood politics.
- Report to its people on the speeches, attendance and voting records of elected officials so they may better know how well they are being served.

Of course, most major U. S. companies have long had a hand in politics—through lobbies and other influence groups. But most previous efforts to influence legislation have been behind the scenes, exerted at the national level and not directed for or against specific parties or personalities.

Now the idea is for companies and their employees to work openly and on an individual basis to improve the caliber of political candidates; to work at the precinct levels where political courses are decided and candidates selected; to work unashamedly in behalf of business interests and against the demonstrated political influence of organized labor.

Whether business men will dare, in fact, to take sides on sticky issues at the risk of alienating customers remains to be seen. But let us hope at least that more objective-minded people are encouraged to enter politics and that company employees at all levels become more aware of what is going on in politics. If only these things come to pass, we'll all be better off.

Boiling Water Reactor Gets International Nod

A seven-man international panel has selected General Electric to design and build a 150,000-kw. nuclear power plant for Italy's Societa Elettro-Nucleare Nazionale (SENN).

GE's proposal for a dual-cycle boiling water reactor won out over eight other bids from four countries involving natural uranium, gas-cooled and pressurized water reactors. The vote speaks well for the boiling water reactor and for the U. S. level of reactor technology.

Construction will begin on SENN's plant near Naples before the year is out, and should wind up by 1963.

GE hopefully regards the decision of the international panel as a big step in establishing the type of plant with the greatest potential for producing competitive nuclear power.

At its Vallecitos Lab in California, GE uses a small boiling water reactor to get operational data for bigger projects. Early this year the company hiked the thermal output of this reactor from 20,000 kw. to 30,000 kw. "without change in design or addition of fuel."

Other GE projects for its commercial boiling water reactors:

- A 180,000-kw. power plant near Chicago for Commonwealth Edison and Nuclear Power Group. Upon completion in 1960 this will be largest all-nuclear plant in the U. S.
- A 50,000-kw. reactor for Pacific Gas & Electric at Eureka, Calif. When completed, it'll be the largest single-cycle, natural-circulation-reactor system yet constructed.
- A 15,000-kw. reactor for West Germany's first nuclear power station. Operation is scheduled for 1960 at Kahl, near Frankfurt. The reactor will utilize low-enrichment uranium oxide fuel and produce 230,000 lb./hr. of 650-psig. steam.

Employment Dislocates Plant

Britain's Board of Trade has rejected British Nylon Spinners' plan to build a $28-million nylon plant near Portsmouth. "We consider," said the Board, "that the firm's needs can be met at any one of several alternative sites where the unemployment rate is higher than in the Portsmouth area."

Foam Plastics Soaring

Cellular plastics production doubled last year (reaching 32 million lb.), is expected to soar to 50 million lb. this year. Big uses: Cushioning for furniture and transportation seating.

POWELL

world's largest family of valves*

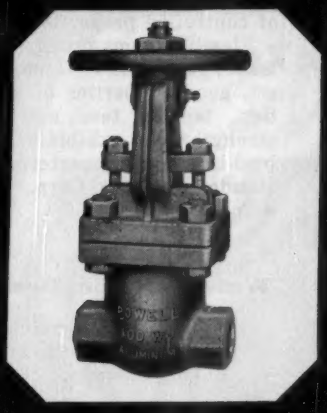

Fig. 2442AL — Aluminum O. S. & Y. Gate Valve for 100 W. P. at 350F. Especially advantageous in laboratories and process plants for piping distilled water and handling acetic and nitric acids. Flanged end valves also available.

Fig. 2600 — New 150-pound Bronze Full Flow Globe Valve. 500 Brinell hardened, stainless seat ring and disc. Nominal pipe size seat opening and extra high lift of disc assure full flow with minimum pressure drop and turbulence. Can be supplied with indicator collar and arm for visual control. 200 and 300 pound valves also available.

Small Flush Bottom Tank Valves for 150 W. P. made in two designs. Fig. 2172 disc opens into tank; Fig. 2173 disc opens into valve. Available in a number of metals and alloys; also for 300 and 600 W. P.

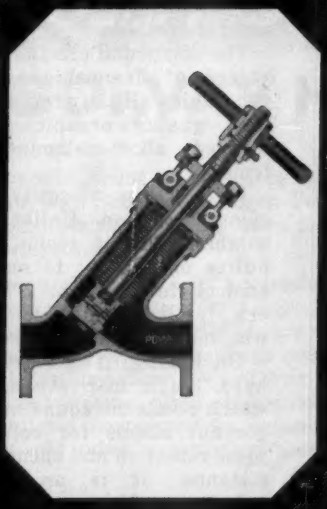

Fig. 2343 — Swing Check Valve for 150 W. P. Bolted Cap. Made in Monel Metal, Nickel and Hastelloy Alloys B-C; and with flanged ends. Valves of this design can also be furnished in stainless steels.

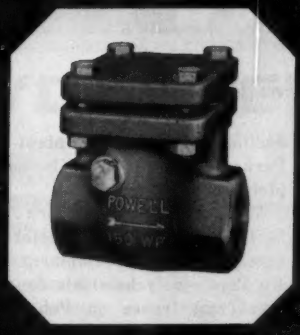

Fig. 1559 — Steel Lubricated Plug Valve for 200 pounds, W. O. G. — A. S. A. 150 pounds. Screwed gland type. Single gland and bolted gland types also available. Large valves—6" and above—can be supplied with gears for gear operation.

Fig. 2107BSW — (Sectional)—Stainless Steel Bellows Seal "Y" Valve for 150 W. P. Designed for high vacuum service—for controlling the flow of heavy water, molten metals and all hazardous, lethal and malodorous fluids.

*and in this family there's a valve for every flow control requirement—for handling water, oil, gas, air, steam and corrosive fluids—available in the most required sizes and types. If your local distributor can't supply you, or if you need specially engineered valves for unusual conditions, write

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DEVELOPMENTS...

CHEMICAL PRODUCTS EDITED BY FRANCES ARNE

Dashboard With a Difference: It's Polyacetal

Experimental automobile instrument panels molded of Delrin acetal resin are inspected by Nobel prize-winning chemist, Hermann Staudinger, center. Delrin, whose development by Du Pont researchers was cited by the scientist as an example of practical achievement based upon his pioneering work, will become the first formaldehyde-based plastic in commercial production when a new plant at Parkersburg, W. Va., is completed next year.

With the professor are Dr. F. C. McGrew, left, director of research and development of Du Pont's polychemicals department and Irenee du Pont, Jr., director of the polychemicals sales service laboratory at Chestnut Run, Del. — Du Pont Co., Wilmington, Del. 84A

Catalyst

Expected to supplant prepolymer techniques for urethane foam.

A new one-shot polyether catalyst used for producing odorless urethane foam has been developed. Called Dabco, it can also be used to produce foam from polyether pre-polymers, dimer acid esters, adipic acid esters, and co-polymers. It is also expected to have application in urethane coatings.

It is expected to supplant the costly, tedious pre-polymer techniques now being used in most urethane foam manufacturing. It can be used to foam any or all commerical polyethers to produce flexible, rigid or semi-rigid foams with a wide range of controlled properties.

Flexible foams produced with Dabco have low compression set, good properties of elongation, tensile, tear and shear strength, and exhibit excellent load-bearing characteristics.— **Houdry Process Corp., Philadelphia, Pa.** 84B

Water-Soluble Resin

Adds to fire safety and simplicity in formulation of baking enamels.

Arolon 1000 is described as the first versatile top coat resin of the water soluble type introduced generally to the industrial finishing industry.

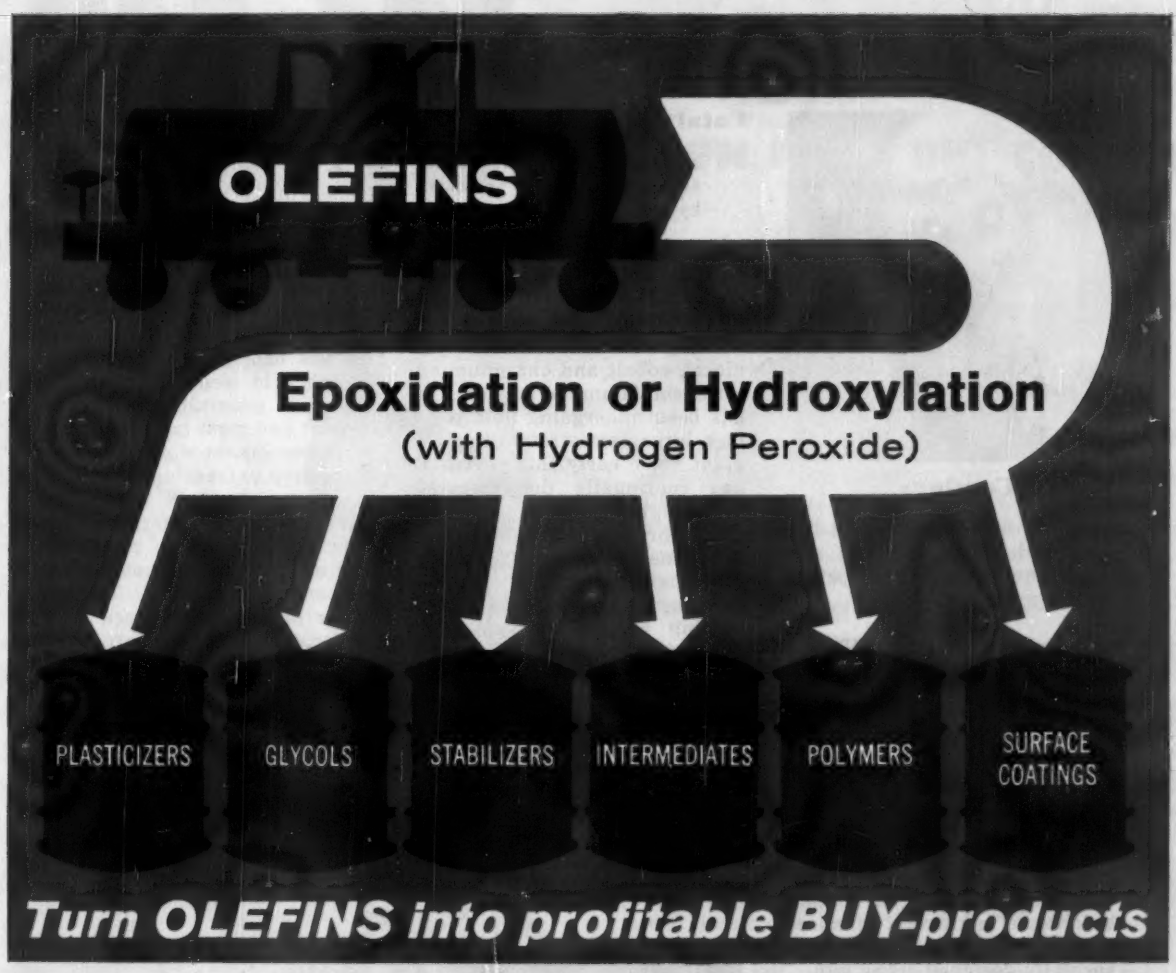
Its manufacturer is now applying for composition-of-matter patents, calls it simply an organic complex.

The compound eliminates the hazard of flammable solvents yet retains all the properties of high quality organic solvent thinned alkyd-melamine systems.

It is a low viscosity, light colored solution. Unlike water soluble emulsion resins, it requires only water to make an enamel formulation. Thickeners, stabilizers, bactericides and wetting agents are not required.

On baking, it converts to a hard, tough, mar-resistant film which rivals melamine modified coconut alkyds for color and gloss retention and chemical resistance. It is an efficient grinding vehicle applicable to customary pigment dispersing techniques and produces enamels stable to storing.

Arolon 1000 is recommended for finishes on appliances, office equipment, metal furniture, interior appointments on automobiles and other metal products using sprayed-on baking enamels. — **Archer-Daniels-Midland, Minneapolis, Minn.** 84C



with SOLVAY HYDROGEN PEROXIDE

You can upgrade olefins by means of epoxidation or hydroxylation with SOLVAY Hydrogen Peroxide to develop new products that open up more profitable marketing opportunities.

Among the products now being successfully produced by this method are: resin plasticizers, glycols, stabilizers, reactivated intermediates, insecticides, polymers, surface coatings, lubricants, waxes, surfactants and brake fluids. Synthetic olefins, and those derived from natural oils, commonly used include: alkyl oleates, terpenes, alkyl tallates, acetylated monoglycerides, natural unsaturated triglycerides and other unsaturated aliphatic hydrocarbons.

Sodium Nitrite • Calcium Chloride • Chlorine • Caustic Soda • Caustic Potash Chloroform • Potassium Carbonate • Sodium Bicarbonate • Vinyl Chloride • Methyl Chloride • Ammonium Chloride • Methylene Chloride • Monochlorobenzene Soda Ash • Para-dichlorobenzene • Ortho-dichlorobenzene • Carbon Tetrachloride Ammonium Bicarbonate • Snowflake® Crystals • Aluminum Chloride • Cleaning Compounds • Hydrogen Peroxide • Mutual® Chromium Chemicals

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Write for this new review and bibliography on epoxidation and hydroxylation with SOLVAY Hydrogen Peroxide as a means of upgrading olefins. It contains facts, describes the methods, and lists many present and potential applications.

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- ☐ Booklet—"SOLVAY Hydrogen Peroxide for Epoxidation or Hydroxylation."
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Epoxy Coatings

Gun solves short pot-life problem, mixes resin and hardener an instant before spraying.

New method of handling epoxy coating permits curing speed of the formulation to be dictated by the requirements of a particular application. In the past, use of epoxy coating has been somewhat restricted by short pot life of fast curing catalyzed systems.

The key to the new system: combining the epoxy resins and the hardener only an instant before the mixture is atomized and sprayed through use of a specially designed spray gun.

Formerly, epoxy formulations that cured fast at room temperatures could only be handled in very small quantities and then only manually, resulting in high labor costs. These have limited the use of epoxies in a number of potential areas such as nonsolvent coatings and reinforced plastics.

The new spray gun is fed resins and the hardener in correct proportions assured through a positive metering system. From the gun's mixing chamber, where they meet and mix, they are forced through an orifice under pressure of 300 psi. Since the spray is created by the pressure of the liquids and not by compressed air, as in conventional guns, overspray and misting are sharply reduced. In turn toxicity hazards are substantially reduced.

Gun and metering equipment were designed and are manufactured by A. Gusmer, Inc., Woodbridge, N. J.—**Bakelite Co., New York, N. Y.** **86A**

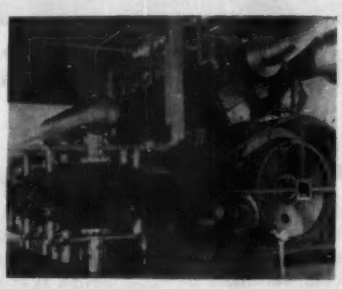
Catalyst

Removes acetylene from olefin streams by selective hydrogenation.

A new type catalyst for the purification of olefin streams by means of selective hydrogenation has been developed.

Designated C36, it contains nickel, cobalt and chromium on a rugged alumina support. It has been undergoing field tests in a large commercial ethylene plant since early this year and has continually demonstrated both high selectivity and activity for the hydrogenation of acetylene in raw sulfur-bearing ethylene streams. It further combines the advantages of permitting high plant capacities without the need for frequent catalyst regeneration to remove deposited polymeric materials.

Extensive new uses for this type of catalyst have also been worked out. These include the purification of propylene and butylenes by selective hydrogenation.—**Catalysts & Chemicals Inc., Louisville, Ky.** **86B**



Coolant

First tailored to ebullient cooling for such stationary engines as above.

Development of the first product specifically designed for use in ebullient cooling—cooling by means of a boiling heat-transfer medium—has been announced.

The product is Dowtherm 209 and it is expected to find an immediate market for cooling large, stationary internal combustion engines.

Whereas in conventional cooling there may be a temperature rise of around 40 F. in the coolant as it travels through the cooling system, ebullient cooling allows a temperature rise of 2 to 3 F. throughout the system. This prevents expansion of cylinder walls, cause of increased oil consumption, metal stresses, friction engine wear.

Though it has been used for over 50 yr. and has these distinct advantages, ebullient cooling has had limited acceptance due to cold weather problems. Water is generally used as a coolant and must have a freeze-point depressant when temperatures drop to freezing. Attempts to use a standard antifreeze have not been generally successful since these materials will not form a constant boiling mixture with water. Though water in the engine itself may be protected, vapors produced by the boiling mixture contain only water which can freeze in the condensate return line.

Dowtherm 209 gives freeze protection both in the engine and the condensate return line. It is recommended for use in a 53% by weight solution in water. Mixture gives protection down to −45 F.—**Dow Chemical Co., Midland, Mich.** **86C**

BRIEFS

Nylon 6 film with excellent sparkle and clarity, high tensile and tear strength, is now being made in developmental quantities. It is available 1.5- to 20-mil thick, in widths to 36 in.—**Foster Grant Co., Leominister, Mass.** **86D**

Alkyd resin, Glyptal ZA-114 solution, has been developed for use in formulating baking enamels requiring color and gloss retention at temperatures in the 400 F. range.—**General Electric Co., Anaheim, Calif.** **86E**

For More Information . . .

about any item in this department, circle its code number on the

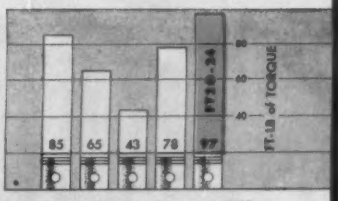
Reader Service

postcard (p. 207)

NEW and outstanding

...ON FOUR BIG COUNTS

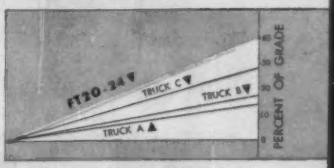
OUT-POWERS . . . with full 35 hp — the most in its class. Better yet, it's honest *industrial* engine power — built to develop high torque at *usable* working speeds for lift trucks.



The engine in the new FT20-24 develops 97 ft-lb of torque.

OUT-MANEUVERS . . . operator steps onto the clean, open platform from either side . . . works comfortably on a wide, cushioned seat . . . spots loads quickly with responsive finger-tip controls . . . turns sharply . . . can have the advantages of optional POWER SHIFT torque converter drive . . . *moves more* day after day.

OUT-CLIMBS other 2,000-lb trucks . . . is sure-footed and tough. Just watch it take steep grades up to 40 percent, loaded. It has extra power, balanced weight distribution and greater lateral stability.



The FT20-24 with full load, will climb a 40% grade.

OUTLASTS . . . bonus strength from mast to rear counterweight keeps it on the job far beyond the usual life expectancy for lift trucks. There is no unnecessary strain on working parts. With automotive-type frame, the engine and drive components are not required to serve as structural members.

Further, the machine can be prepared for service in seconds — stripped for overhaul in minutes — and returned to work hours, even days, sooner than most machines.

How about a demonstration! Let your Allis-Chalmers dealer *show* you how the all-new FT20-24 can out-perform, and bring substantial savings in material handling costs. Send for NEW, FREE Booklet BU-485. Allis-Chalmers, Milwaukee 1, Wis.

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ALLIS-CHALMERS
FT20-24
2,000-LB
LIFT TRUCK

ENGINE: Industrial-type — Gasoline or LP Gas

Displacement	133 cu in
Horsepower	35 at 2,400 rpm
Torque, ft-lb	97 at 1,400 rpm

GRADABILITY:

Truck will climb with full load - - - - 40% grade

DRIVE:

Standard or (optional) POWER SHIFT with torque converter

LIFTING:

Standard lift	131¼ in.
Lifting speed, loaded	50 fpm
Tilt angle	10°

Compare Performance . . .
Compare FT20-24 Specifications . . .
Compare Price!

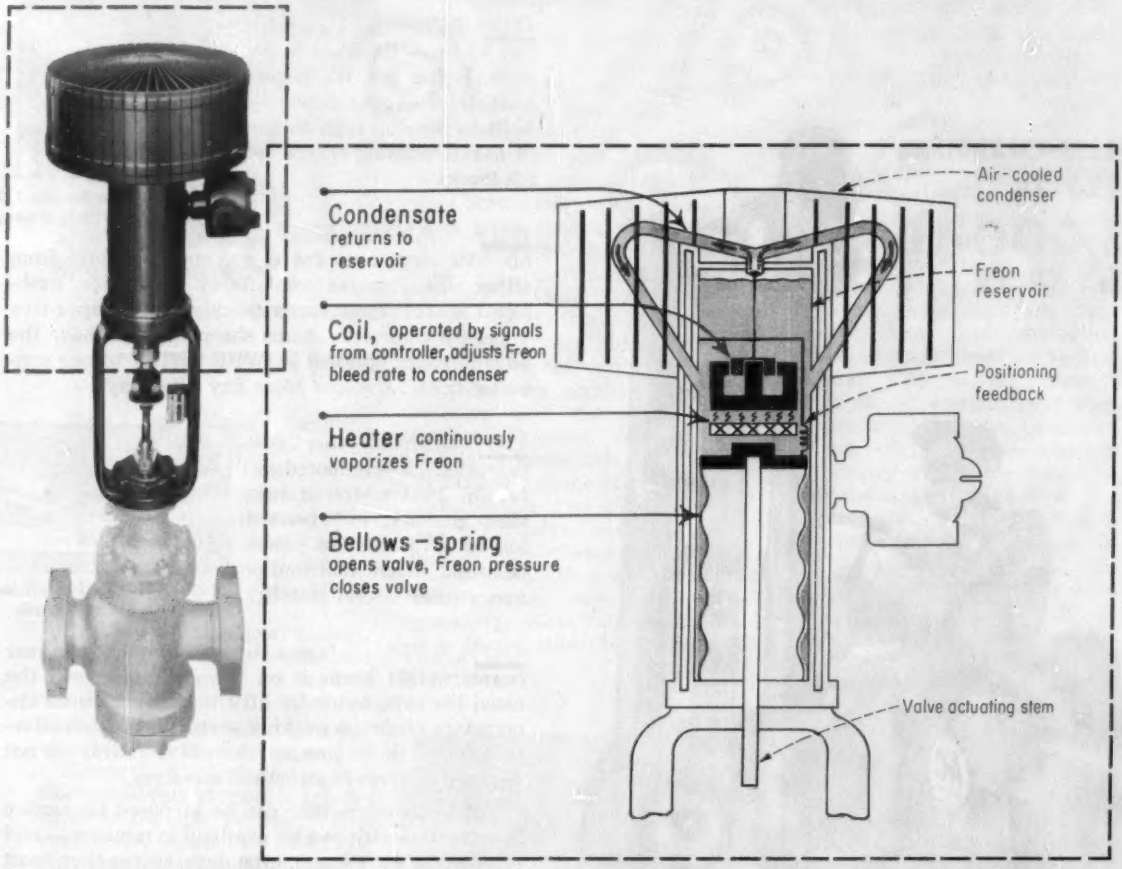
DIMENSIONS:

Length to front face of forks	69 in.
Width, maximum	32 in.
Minimum intersecting aisles truck negotiates	55½ in.
Turning radius, outside	62 in.

TIRES:

Drive	18 x 5 x 12⅛ in.
Steer	16¼ x 4 x 11¼ in.

ALLIS-CHALMERS



Vaporized Freon Drives Valve Operator

Simplicity, economy and accuracy characterize the unique Thermo-Drive actuator, a new equipment item for electronic control systems.

Take a cylinder, closed at one end, and pour in some Freon. Place a piston in the open end; then heat the Freon. What happens? Obviously, a rise of pressure within the cylinder causes the piston to move.

Now put a pressure-relief valve somewhere in the apparatus. By careful manipulation of the valve, you can hold the piston in any position, regardless of how much heat is entering the system.

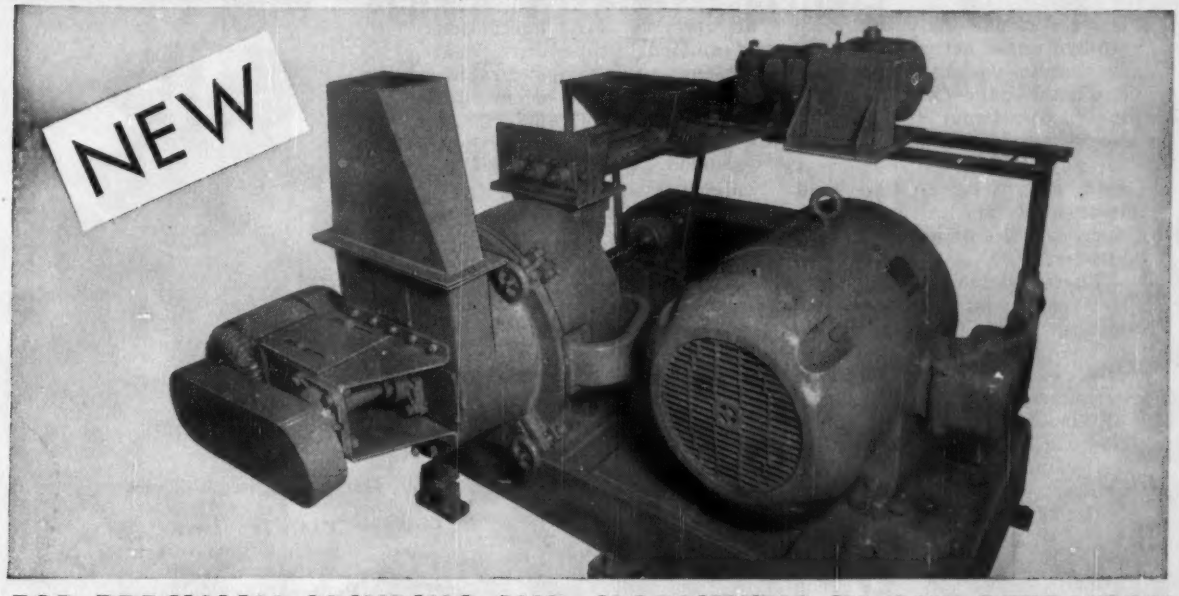
Essentially, the simple device described above illustrates the principle of operation of a unique new tool for the process industries—Swartwout Co.'s Thermo-Drive actuator for electronic control systems.

▶ **Fits Most Valves** — Thermo-Drive revises present concepts of automatic control. It utilizes the expansive force of Freon vapor to position valves and other final control elements with precise and repeatable accuracy.

At present, the new actuator is in the field stage, with several units operating in the plants of major companies on a test basis. Swartwout claims that the new actuator will fill the bill in 95% of all valve installations—that is, all except those in which exceptionally high response speeds or pressures are involved.

▶ **Check These Features**—Principal advantages of Thermo-

NEW PRODUCT NEWS



FOR PRECISION GRINDING AND CLASSIFYING IN ONE OPERATION

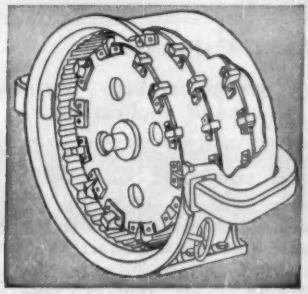
The PULVOCRON . . . An Air Attrition Impact Pulverizer and Classifier with Controlled Radial Inward Air Classification.

Now in one compact unit you can have a pulverizer and a classifier plus an automatic feeder, with separate controls over each. This assures positive particle size control and high capacity over a wide range of products. The Pulvocron will produce particle sizes from a range of 99% less than 5 microns or as coarse as 50 mesh, depending on the material and desired results.

The grinding chamber contains three adjustable plates with twelve staggered beaters on each. It also features added versatility through interchangeable liners of corrugated, perforated or smooth finish, plus variable rotor stator clearances.

The Classifier unit is on a hinged section with quick-open locks for simplicity of operating adjustment or cleaning.

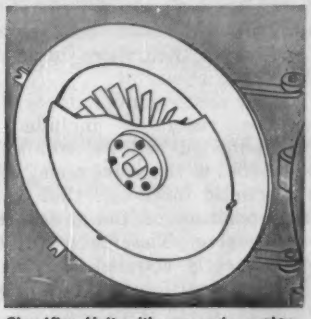
Material is both ground and classified through high centrifugal pressures set up by the beater and classifier plates. The Pulvocron is designed with oversize returns for automatic feed back of any oversize for further grinding.



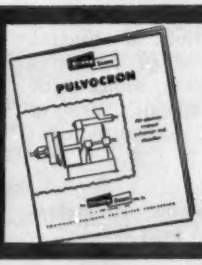
Grinding chamber with adjustable plates, removable liners and oversize returns.

CONSULT STRONG-SCOTT

Strong-Scott offers you a modern up-to-date laboratory containing specialized testing equipment. This is backed by an expert engineering staff to furnish layout and design service at no additional cost to you.



Classifier Unit with separate motor. Swings open as a hinged section with quick open locks.



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The **Strong Scott** Mfg. Co.

DEPT. CE-NPB6-645

Equipment Designed for Better Processing

451 TAFT STREET N.E., MINNEAPOLIS 13, MINNESOTA

Drive over pneumatic and electro-hydraulic actuators lie in its simplicity and low operating and maintenance costs. According to Swartwout, the new actuator requires no maintenance or adjustment under normal field conditions. Actual field tests proved the unit to have an operating life of over 1 million strokes.

Thermo-Drive is completely self-contained and has only two moving parts. It demands neither the air lines and compressors common to pneumatic actuators, nor the motor drive of electro-hydraulic systems—no gear trains, no oil, no magnetic amplifiers, transistors nor relays.

Both moving parts, as well as all electrical components, are not only hermetically sealed, but are also submerged in the Freon—a non-corrosive, dielectric fluid. Thus, they are permanently insulated and protected from the atmosphere. Such sealing not only prolongs actuator life, but also makes the unit explosion-proof and suitable for use in hazardous (Division 1) locations.

▶**Here's How It Works**—Under static conditions, constant output from an electric immersion-type heating element causes continuous vaporization of Freon. The vapor bleeds through a pressure-relief valve into an air-cooled condenser. Condensate then flows back to the Freon reservoir.

Other components submerged in the reservoir include a spring-loaded bellows, which is connected to the valve stem, and a magnetic force coil that controls position of the pressure-relief valve. The force coil is also directly coupled to a mechanical position-feedback loop of comparable sensitivity.

Command signals from any electronic controller, when received by the force coil, cause the pressure-relief valve to bleed either more or less vapor into the condenser. If the relief valve closes, pressure builds up in the reservoir. This compresses the bellows, thus causing a downstroke.

Conversely, an increase of bleed rate allows pressure to drop, and the bellows goes into an upstroke. Mild fluctuations of ambient temperature, heating-element voltage and radiant energy have little or no effect on Thermo-Drive's operation.

▶**Vital Statistics**—Power input (200-300 w.) to the heater is the only operating expense. Original cost of Thermo-Drive actuators will run about $300, considerably higher than pneumatic operators.

General specifications are as follows: Input resistance, 12,000 ohms; Input range, 1 to 5 ma., d.c.; Sensitivity, 0.1% of input range; Response, 0.1 in./sec.; Repeatability, 0.5%; Stroke, 1.5 in.; Maximum stem loading: actuating force of 500 lb. opposed by 300-lb. spring.

Because Freon is non-corrosive, materials of construction are no great problem. Both casing and bellows are stainless steel; the radiator is copper.—**The Swartwout Co., Cleveland, Ohio.** **88A**

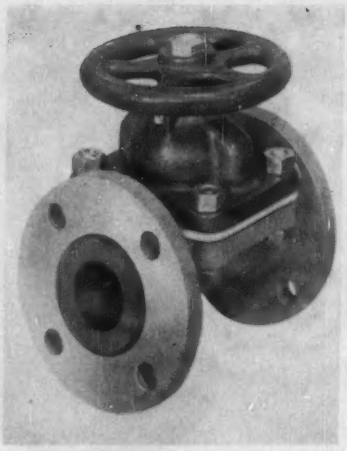
Gas Detector

Conductivity measurements give concentration data.

Air pollution studies and process monitoring may benefit through application of a new gas detector. The instrument continuously measures, indicates and records varying minute traces of a large number of gases and vapors. Immediate response and high sensitivity of the tool enable detection of instantaneous concentrations as low as a few parts per billion.

Two streams feed into the detection chamber—one, the gaseous sample containing the contaminant; the other, a sensitizing reagent that reacts with the contaminant to form smoke or mist particles. Different reagents provide selectivity when detecting a variety of contaminants.

Within the chamber, emissions from a radioactive source cause ionization of the sample. Electrical measurement of the sample's conductivity, which bears a relationship to ion population, gives an accurate indication of contaminant concentration. — **Mine Safety Appliances, Pittsburgh, Pa.** **90A**



Diaphragm Valves

Plastic lining guards against chemical attack.

Penton, a chemically resistant plastic for working temperatures to 300 F., now lines a series of diaphragm valves. The valves, offered with cast iron or aluminum bodies, are compatible with glass, plastic, metallic and lined piping.

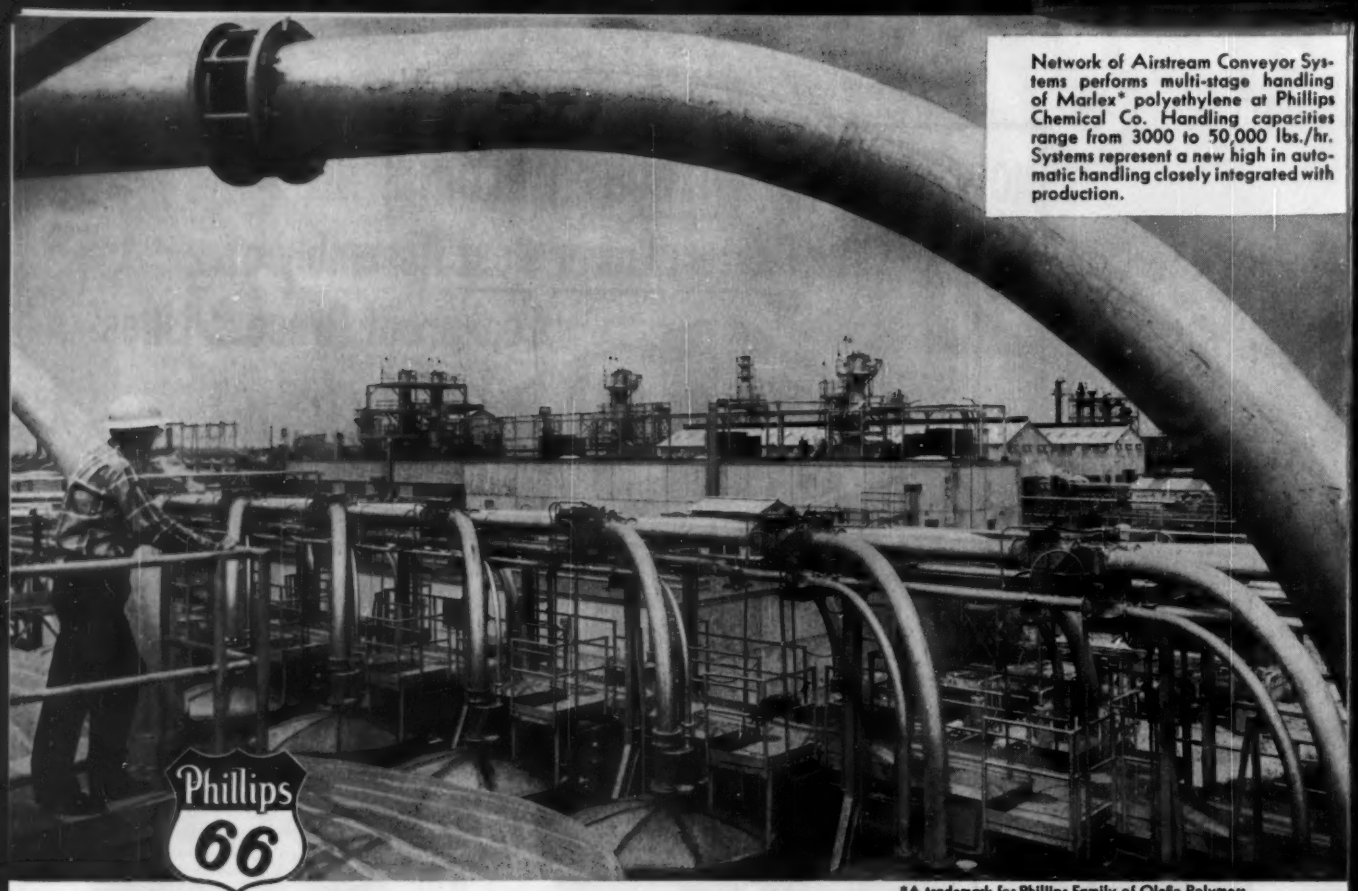
Priced competitively, the new series comes in sizes from ½ to 6 in., with flanged ends only. Handwheel, quick-opening air or electric operators are optional. — **Hills-McCanna Co., Chicago, Ill.** **90B**

Data Collector

System revamp broadens scope of application.

Data-Gage, an instrument system previously manufactured for fluid-level data collection, is now applicable to any industrial operation requiring both data collection and remote control of on-off devices. One of the system's chief features is complete verification of data accuracy and station identification prior to information display or actuation of control power. And, use of semiconductor components, along with conservative circuit design, minimizes maintenance requirements.

This and other equipment developments continue on page 192.



Network of Airstream Conveyor Systems performs multi-stage handling of Marlex* polyethylene at Phillips Chemical Co. Handling capacities range from 3000 to 50,000 lbs./hr. Systems represent a new high in automatic handling closely integrated with production.

*A trademark for Phillips Family of Olefin Polymers.

At new polyethylene plant . . .

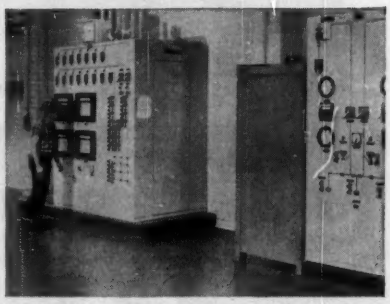
Phillips uses *Airstream* Conveyors for bulk materials handling

Phillips Chemical Co. uses Dracco Airstream Conveyors for bulk handling of polyethylene at its Pasadena (Texas) plant. Three main conveyor systems, consisting of a dozen subsystems, total 10,500 feet in length. These provide high-volume, high-purity handling demanded by Phillips' advanced processes.

All systems are closely integrated with production from the time polyethylene becomes a dry bulk material until it is shipped to plastics processors. Handling is contamination-free. Controlled atmosphere conveying techniques, with inert gas as the conveying medium, are used as required. Centralized, automatic control is extensively employed.

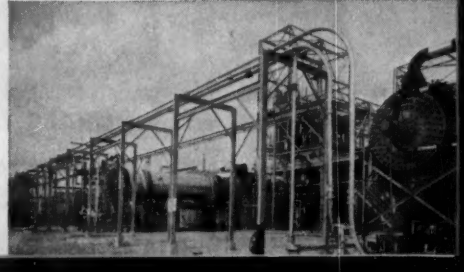
The Dracco systems at Phillips exemplify the future potential of pneumatic conveying in meeting industry's needs for handling dry materials in bulk throughout production. Design and fabrication required a comprehensive "systems approach" to air conveying, incorporating intimate knowledge of instrumentation, production processes, continuous flow principles, construction materials and bulk material characteristics.

For this approach to your handling problem, contact Dracco today.



Typical conveyor system control panels at Phillips. All systems are completely interlocked to block out control equipment on other panels which may conflict with a given conveying operation.

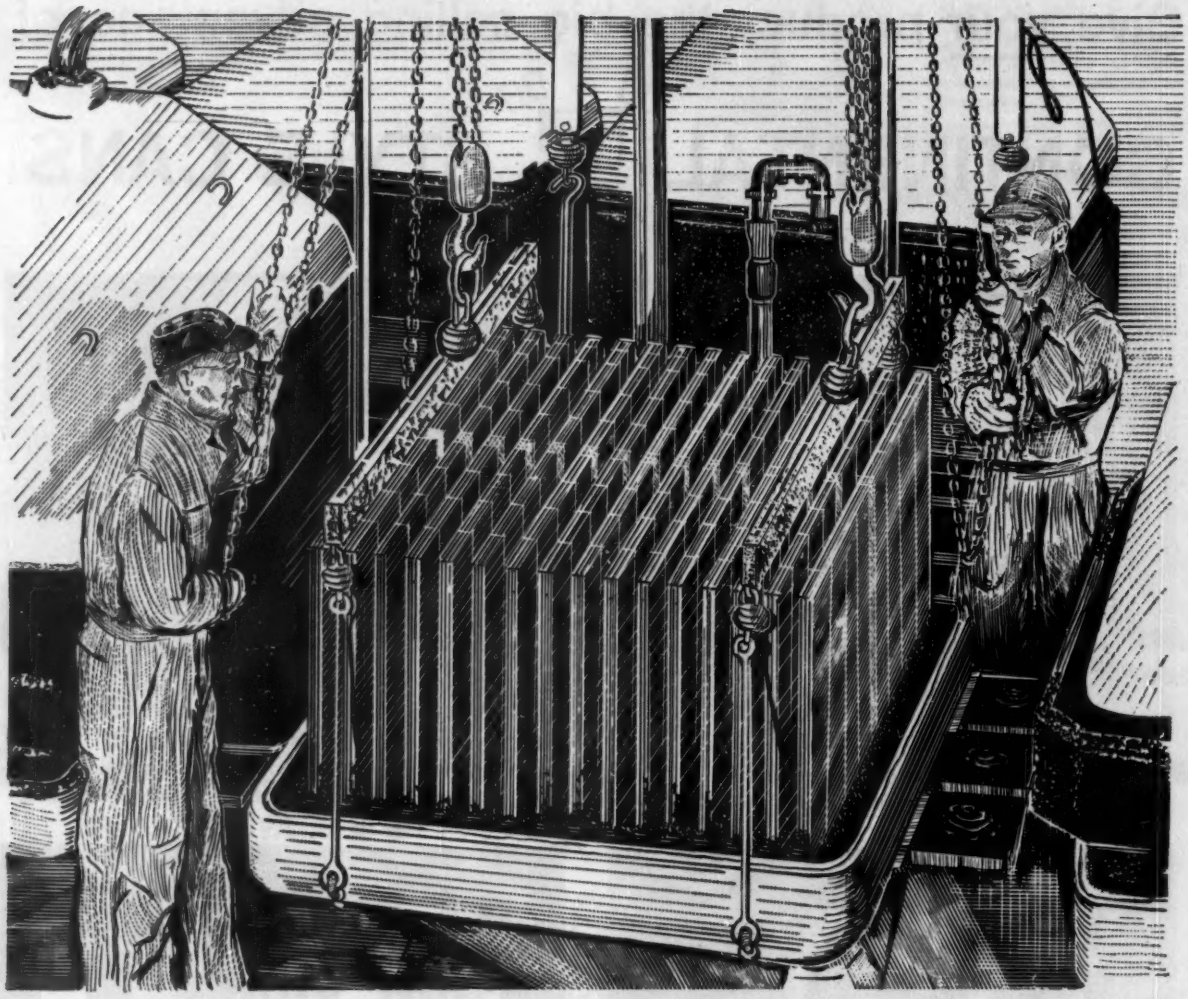
Pneumatic handling starts at dryers. Closed-circuit system uses inert gas to convey "fluff" polyethylene to processing building.



DRACCO DIVISION OF FULLER CO.

4040 East 116th Street • Cleveland 5, Ohio

DRACCO *airstream* conveyors
dust control equipment



Efficiency in the making

Depth of experience in the building, installation and operation of Hooker cells is a highly important factor in their production efficiency.

High efficiency is also a characteristic of **GLC Anodes,** which are "custom made" to individual cell requirements.

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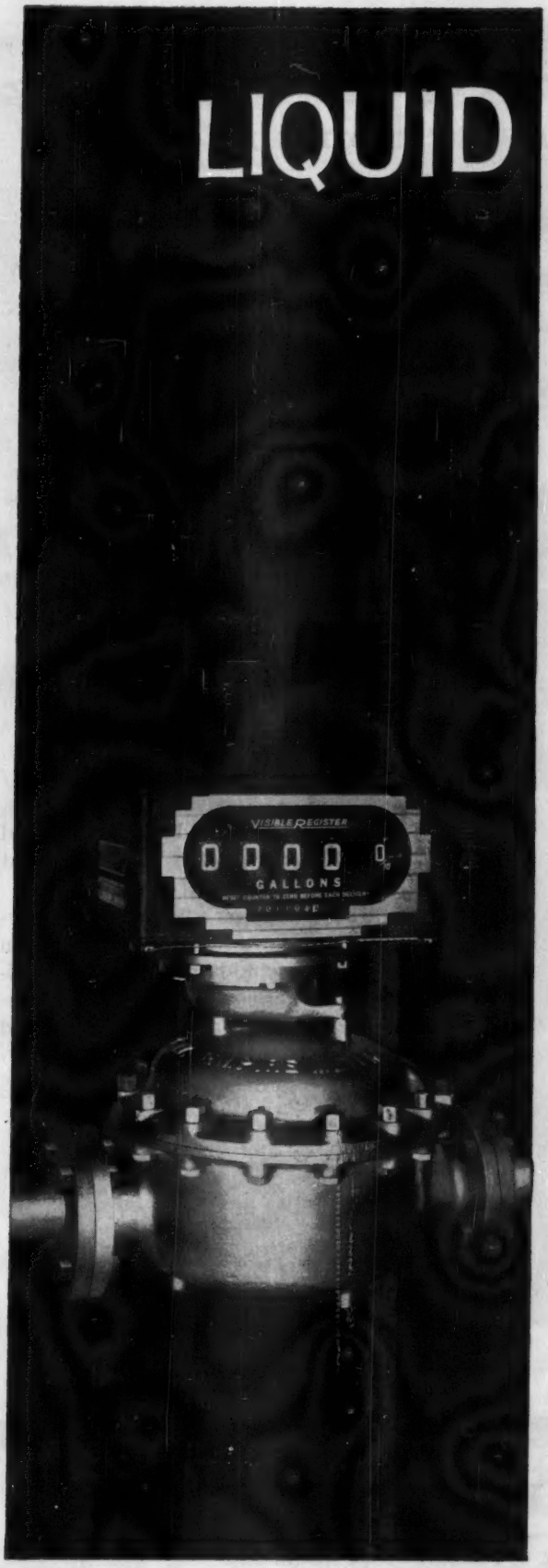

LIQUID METERING

CAN BE SIMPLE, INEXPENSIVE . . .

and Save You Money!

Perhaps you've felt the need to meter your industrial liquids but have hesitated because you feared metering was costly or complicated. Actually, even a plant-wide installation of simple, direct reading Rockwell meters can be made very easily and for a nominal investment. They will pay their way many times over by providing realistic records for cost, inventory and utilization controls.

Measure Even Corrosive Liquids. Among the many types of Rockwell meters, there is the right design to measure most anything that flows . . . including *all stainless-steel meters* for corrosive liquids.

If you blend, batch or package liquids, Rockwell meter accessories such as automatic shut-off controls, impulse counters and remote registration will cut your costs and increase production. Use the coupon for full details.

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Pittsburgh 8, Pa.

Gentlemen

I am interested in measuring _____
(Name of Liquid)

Pipe Size _____"

Working Pressure _____ psi Temperature _____ °F max.

Max. Flow Rate _____ gpm Min. Flow Rate _____ gpm

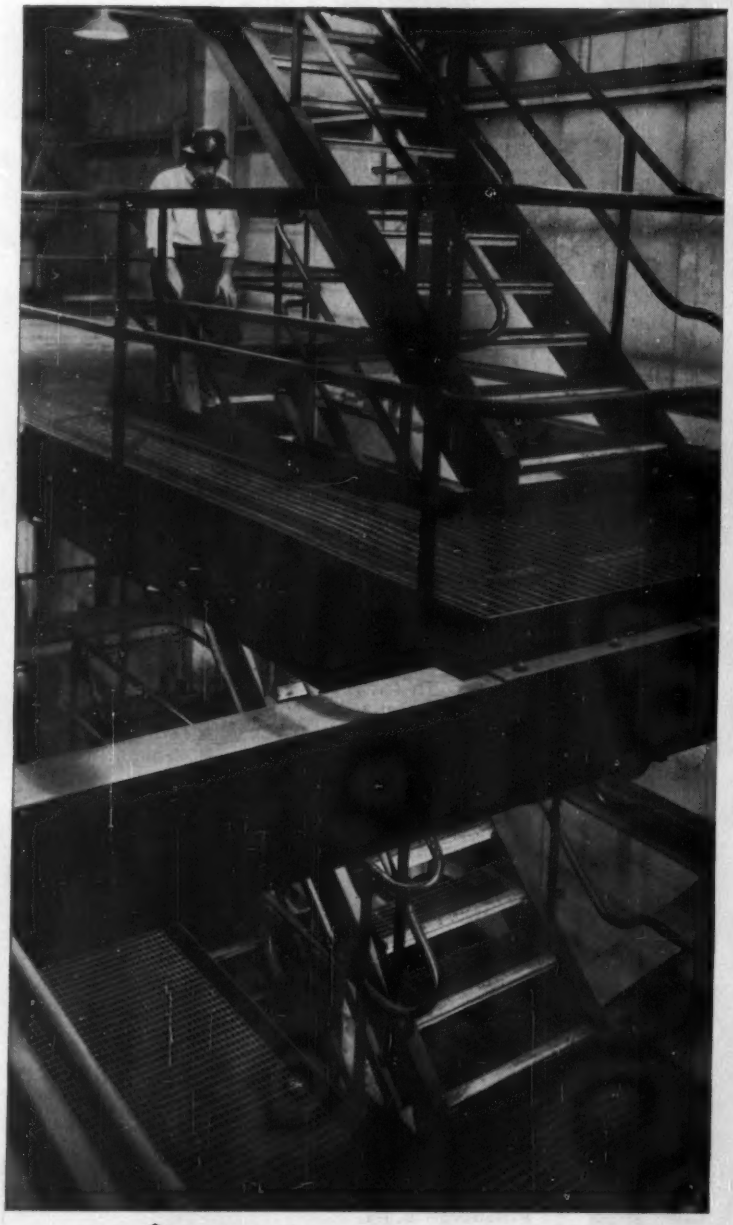
Your Name _____

Company _____

Street _____

City _____ Zone _____ State _____

Where a misstep costs $500... Blaw-Knox Electroforged® Steel Grating provides safer non-slip footing



Stair falls cost industry over $60,000,000 a year.

An average accident amounts to a loss of $500 in claims.*

A good way to guard against these profit-eating accidents is to construct your stair treads, walkways and floors with Blaw-Knox Electroforged Steel Grating. Non-slip twisted crossbars and a wide variety of bearing bars are available to meet every kind of working condition—safely solving the most hazardous skid situations.

Rigid, one-piece construction makes installation easy. Once on the job, Blaw-Knox grating practically takes care of itself. There is nothing to wear, nothing to patch, no dirt collecting corners to clean. It goes anywhere, fitting neatly around pipes, beams and machinery, admitting plenty of light and air to the area.

Made to your specifications, Blaw-Knox grating provides new highs in safety, easy up-keep and flexible application. For new ideas about grating—including space saving platforms and shelving, write for Bulletin 2486.

*Based on a study analyzing 803 compensable work injury claims closed in Illinois involving stairs and steps.

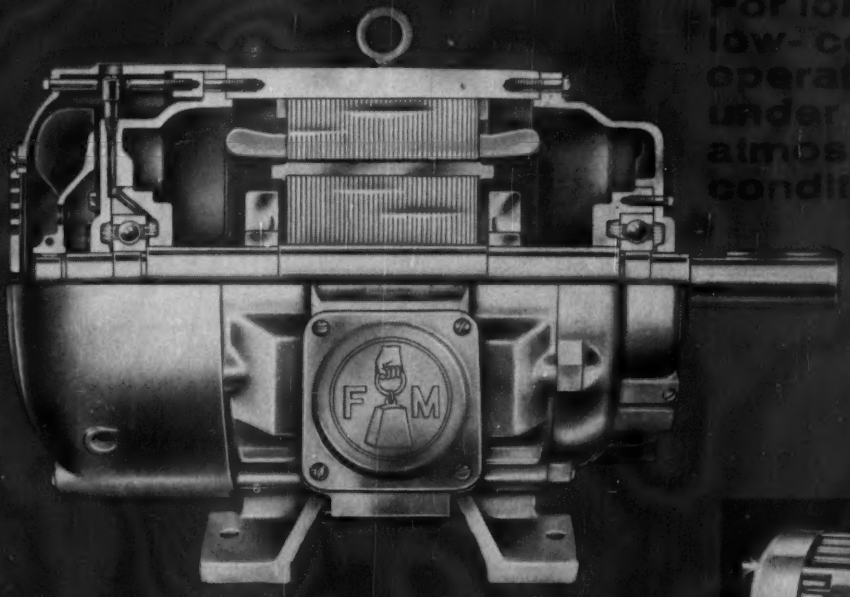
BLAW-KNOX

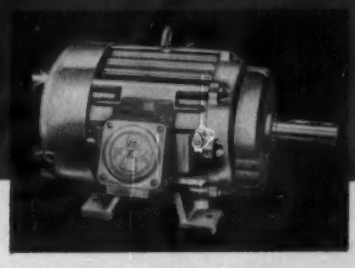
BLAW-KNOX COMPANY

Equipment Division
Dept. C, Pittsburgh 38, Pennsylvania

Here Is Your Motor

For long-life, low-cost operation under adverse atmospheric conditions





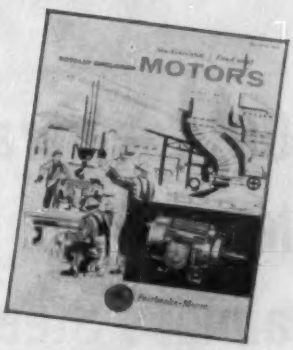
NEW

Fairbanks-Morse Totally-Enclosed Fan Cooled With Controlled-Stream Air Flow!

New Fairbanks-Morse design confines air stream to surface of motor—provides extremely efficient cooling, prevents dust and dirt accumulation. Combines advanced design innovations with long-proven F-M features.

See why these all-new F-M motors warrant your investigation *now* for severe service involving dirt, dust, metal turnings, or abrasive particles; corrosive vapors, steam, excessive moisture, etc.

Write today for new Bulletin 1205, giving complete information on new F-M Totally-Enclosed Fan-Cooled (Type KZC, in larger frames) and Non-Ventilated Motors (Type KZE, in smaller ratings). Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill.

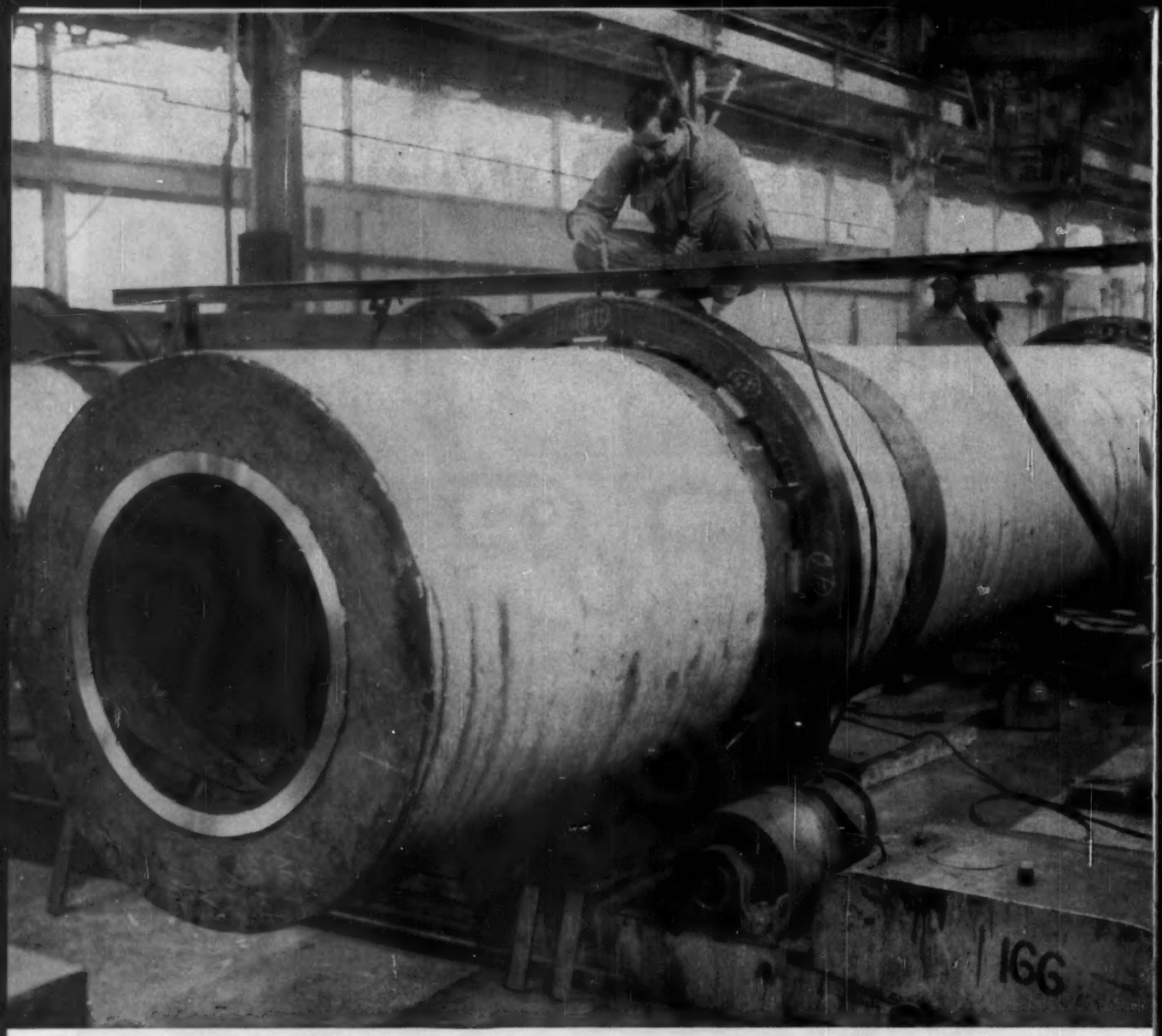


ASK FOR NEW F-M BULLETIN 1205

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES AND ENGINES • COMPRESSORS • PUMPS • SCALES • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS



1600° temperature dries salt in Stainless Steel

You're looking at a Stainless Steel rotary salt drier. It's used to demoisturize salt, one step in making high octane gas.

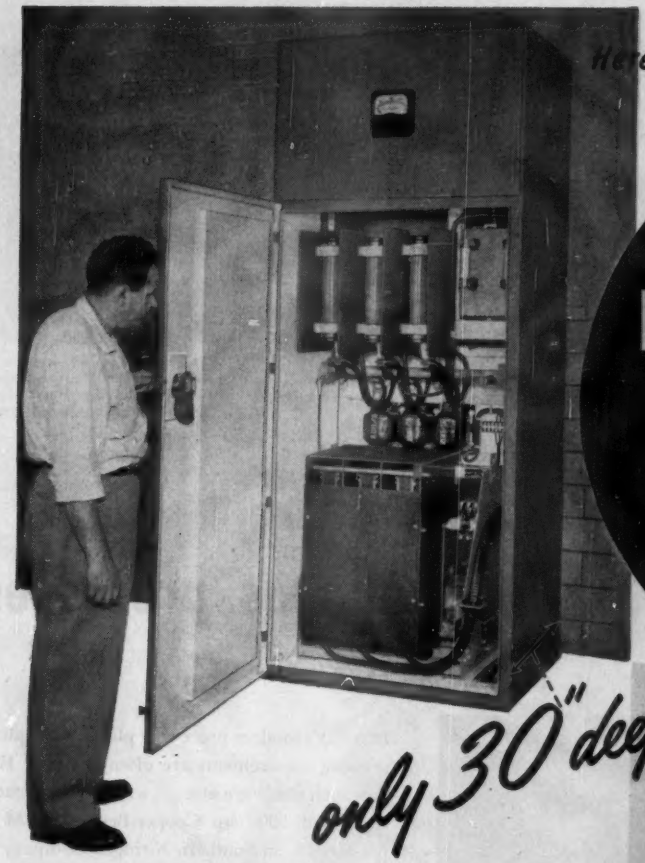
C. O. Barlett & Snow Co., Cleveland, Ohio, built the drier with Stainless Steel because of all the materials tested, Stainless Steel stands up better under the tremendous heat—1600°F.—of the combustion gases used to dry the salt. And because Stainless is corrosion resistant, it can handle the salt, which has a moisture content as high as .5% when it's fed into the drier.

The salt comes out of the drier in a dry and free-flowing state. It's placed in electrolytic cells where it's reduced to chlorine, a by-product, and molten sodium, the ingredient for high octane gas.

Equipment designed for high heat and corrosion resistance wears better and lasts years longer when it's built with Stainless Steel. Specify Stainless Steel for your plant equipment. And if you want service-tested quality, specify USS Stainless Steel. *USS is a registered trademark*

United States Steel Corporation—Pittsburgh
American Steel & Wire—Cleveland
National Tube—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

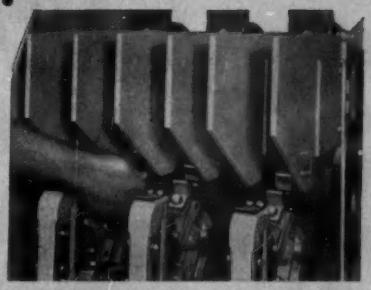
USS United States Steel



Here is **DESIGN LEADERSHIP...** *in Action!*

3-way Padlock Protection WITH EC&M Air-Break High Voltage (2200-4800 VOLTS) Starters

only 30" deep!



NO DRAW-OUT NEEDED • Arc shields slide out horizontally, making front and rear contact-tips removable with standard wrench.

Accessible from Front...

(Solid back) • Starters may be mounted against wall or in double row, back to back

EC&M's door-and-disconnect interlocking system gives you 3-way padlocked safety. The gang-operated Disconnect Switch may be padlocked (1) in the "ON" position or (2) in the "OFF" position—both with the starter door closed. (3) The door opens only by backing out captive thumb screws after the contactor and disconnect are open. For **COMPLETE SAFETY**—Disconnect Switch blades engage grounding clips in the open position.

EC&M's simple interference interlock permits manual operation of the contactor to check contact alignment, shaft rotation, and electrical interlock engagement. No roll-out is needed for any maintenance—contacts, operating coil, and control contacts are fully accessible within the enclosure.

EC&M starters are furnished with a control transformer. Since the bus is located in an isolated upper compartment, only one feeder is required for a group of starters.

Write for **BULLETIN 8130-F**

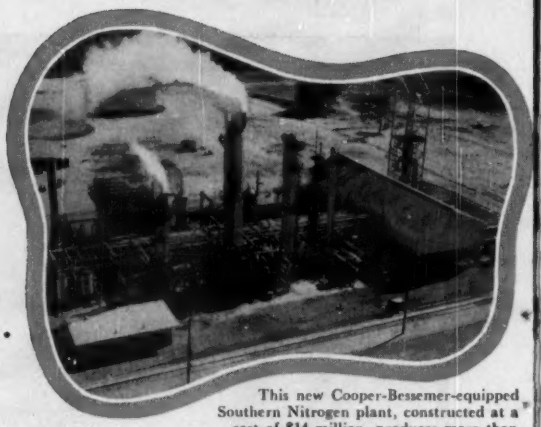
3 Interrupting Ratings for Squirrel Cage, Synchronous and Wound-rotor Motors

1. **CLASS E 1** • 50,000 KVA (symmetrical) based on certified tests.
2. **CLASS E 2** • With current limiting fuses and high interrupting capacity contactor. At 2300 volts: 150,000 KVA, 3 phase; 60,000 RMS amperes asymmetrical. At 4,800 volts: 250,000 KVA, 3 phase; 60,000 RMS amperes asymmetrical.
3. **VALIMITOR®** • May be used on a bus of unlimited short circuit capacity, through the use of a contactor with an interrupting rating of 50,000 KVA, and reactors which limit any fault current to a maximum of 25,000 KVA.

THE ELECTRIC CONTROLLER & MFG. CO.
A DIVISION OF THE SQUARE D COMPANY
CLEVELAND 28 • OHIO

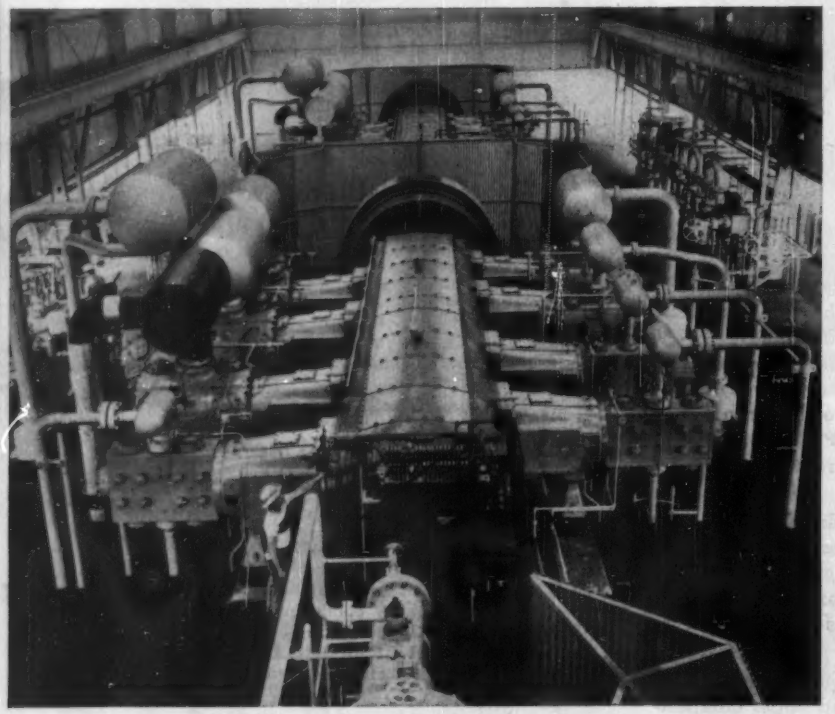
7955-E

At Southern Nitrogen's huge new plant...



This new Cooper-Bessemer-equipped Southern Nitrogen plant, constructed at a cost of $14 million, produces more than 250 tons of ammonium nitrate a day.

unitized operation with only two Cooper-Bessemers handling all gas processes!



These two 8-cylinder Cooper-Bessemer LM compressors, each rated 5000 hp at 250 rpm, handle all required process work in the Savannah plant of Southern Nitrogen.

In today's modern processing plants, multiple compressing requirements are often the rule. Here is how such needs are met . . . with two automatically controlled 5000 hp Cooper-Bessemer LM compressors . . . in Southern Nitrogen Company's new synthetic ammonia plant at Savannah, Georgia.

On each LM compressor, one bank of cylinders handles compression of the gas mixture in four stages to 5125 psi. In the second bank of cylinders, one cylinder compresses pure ammonia gas, while the remaining three cylinders compress a mixture of nitrogen, hydrogen and air in three stages to 150 psi for the reforming furnace.

Cooper-Bessemer process compressors, reciprocating or centrifugal, offer the modern flexibility, extreme availability and efficiency that add up to high volume processing with minimum machinery and attendance. To be sure your files contain complete information, send for the latest bulletins.

BRANCH OFFICES: Grove City • New York • Chicago Washington • San Francisco • Los Angeles • Houston Dallas • Odessa • Minneapolis • New Orleans Shreveport

SUBSIDIARIES: COOPER-BESSEMER OF CANADA, LTD. . . . Edmonton • Calgary • Toronto • Halifax
COOPER-BESSEMER INTERNATIONAL CORPORATION . . . New York • Caracas • Mexico City

Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS • DIESEL • GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN

The complete series of HARBISON-WALKER PLASTIC and CASTABLE REFRACTORIES

can assure the proper selection for maximum life and economy

In addition to the wide range of service temperature limits as here illustrated, these monolithic refractories possess the many different combinations of physical and chemical properties needed for best protection against widely diversified destructive factors. From these brands the best balanced selection can be made for adequately withstanding the most severe operating conditions. Some examples of the many destructive influences against which maximum resistance is needed, are: corrosion by slags, fuel ash and various other fluxes; thermal shock; disintegrating action of gases; erosion by molten metals and slags; mechanical stresses at the high working temperatures.

To help secure maximum service from these refractories, Harbison-Walker freely offers engineering service, recommendations based upon wide experience, and quality-controlled products.

HARBISON-WALKER REFRACTORIES CO.
AND SUBSIDIARIES GENERAL OFFICES: PITTSBURGH 22, PA.
World's Most Complete Refractories Service

TYPICAL FURNACE APPLICATIONS: ARCHES • ASH PITS • BOILER SETTINGS • BREECHINGS • BURNER BLOCKS • BAFFLES • CATALYTIC REACTORS • DOOR LININGS • DUCTS AND PIPING • HEARTHS • INSULATION • KILNS AND CARS • LADLE LININGS • ROTARY KILN CHAIN SECTIONS • SOAKING PIT COVERS

RING OF STEEL

Defies Pressure Times Ten

The Flexitallic gasket in the bonnet joint of Hancock Steel Gate Valves cannot blow out even if pressures exceed ten times the rating of the valve. Valve maintenance and equipment down-time are greatly reduced. Made of a spiral-wound ribbon of stainless steel with asbestos filler, the gasket has spring-like compressibility — cannot be flattened.

Only the specially-designed Hancock bonnet joint with built-in compression limit can make full use of the positive sealing power of this ring of steel. Such advanced valve engineering is one example of total Hancock quality that assures trouble-free performance. Your nearby industrial supply distributor will gladly explain every economy feature of Hancock Steel Gate Valves. Phone him today.

Hancock 800# Steel Gate Valve, Type 950. Sizes: ¼" thru 2".

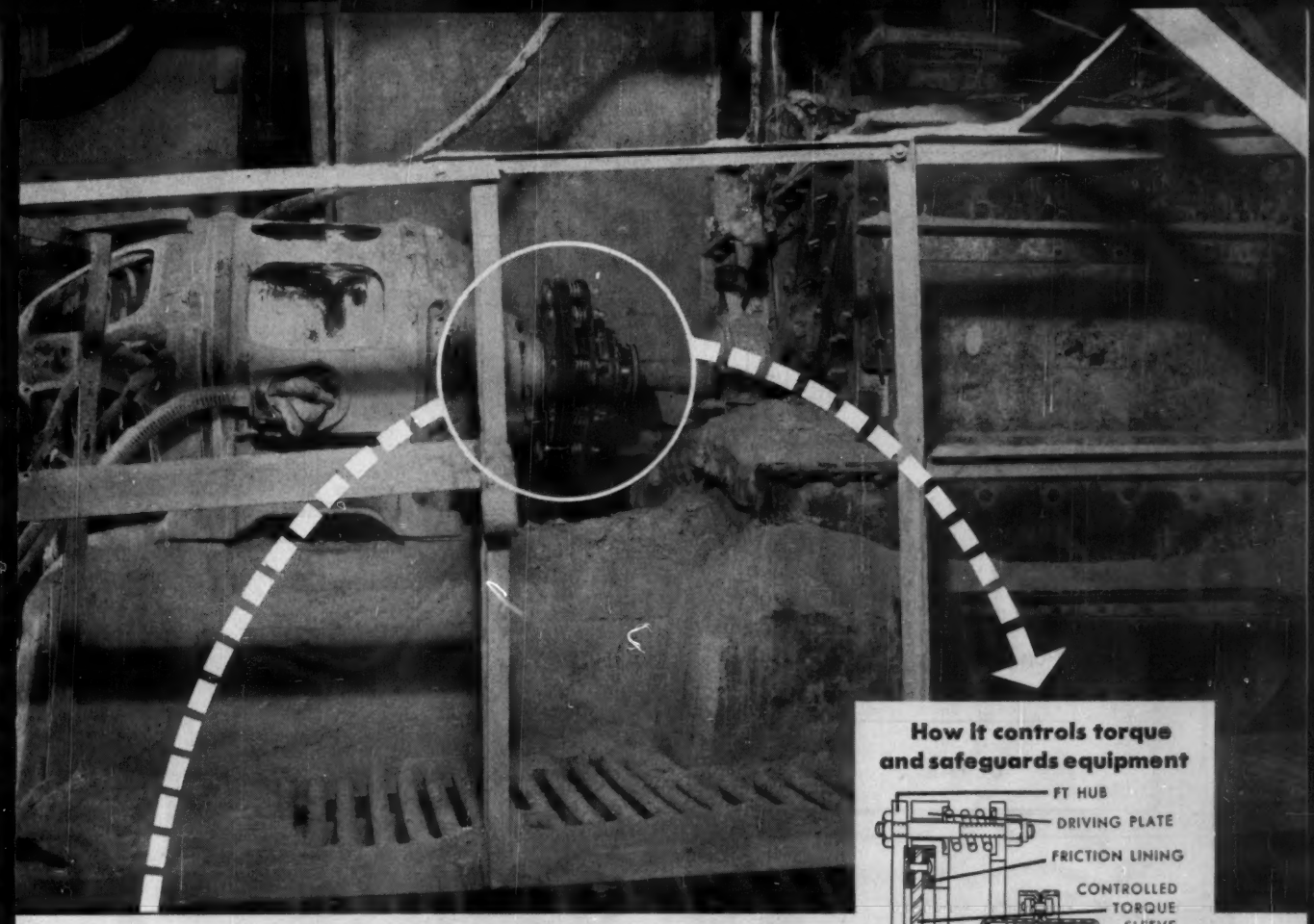
MANNING MAXWELL & MOORE INC. M&M TRADE MARK

HANCOCK STEEL VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Watertown, Massachusetts
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario



How it controls torque and safeguards equipment

Protect machines from overload damage with FALK Controlled Torque Couplings

The above picture shows a Falk Controlled Torque Coupling connecting a 150 hp motor to a hammermill. Formerly, when tramp iron got into the mill, it was necessary to rewind the motor at least twice a year. But, in the 2½ years after installing a Falk Controlled Torque Coupling, no motor repairs were required. *That is real saving!*

Wherever overload danger exists, a Falk Controlled Torque Coupling gives positive protection against machinery damage from excessive torque or jams. This unique coupling has an adjustable friction slip clutch which can be set at *any* predetermined torque limit. Thus, transmission of dangerous shocks is prevented...overloads are limited...shaft breakage is eliminated.

Another big advantage is that, when the cause of the overload is removed, the entire coupling will rotate and transmit power without resetting, and *without replacing parts or repairing the coupling*....And, the Controlled Torque Coupling incorporates the famous Falk Steelflex torsional resilience to smother ordinary shock and vibration, plus the ability to accommodate shaft misalignment....Consult your Falk Representative or Authorized Falk Distributor. **Ask for Bulletin 4100.**

Here (as in photo), the torque-control hub is shown mounted on driving shaft. From this hub, power is transmitted through friction lining to controlled torque sleeve. Load to be transmitted is determined by the (pre-set) pressure on friction lining. In case of overload, this hub still rotates until power is shut off—but the rest of the coupling and the driven machine will slow down or stop.

Motor Shut-off Control

By adding an automatic cut-out switch with V-belt connection to driven shaft, motor can be stopped immediately. With the standard hub mounted on driven shaft, the switch opens the electric circuit when speed of switch falls below predetermined value.

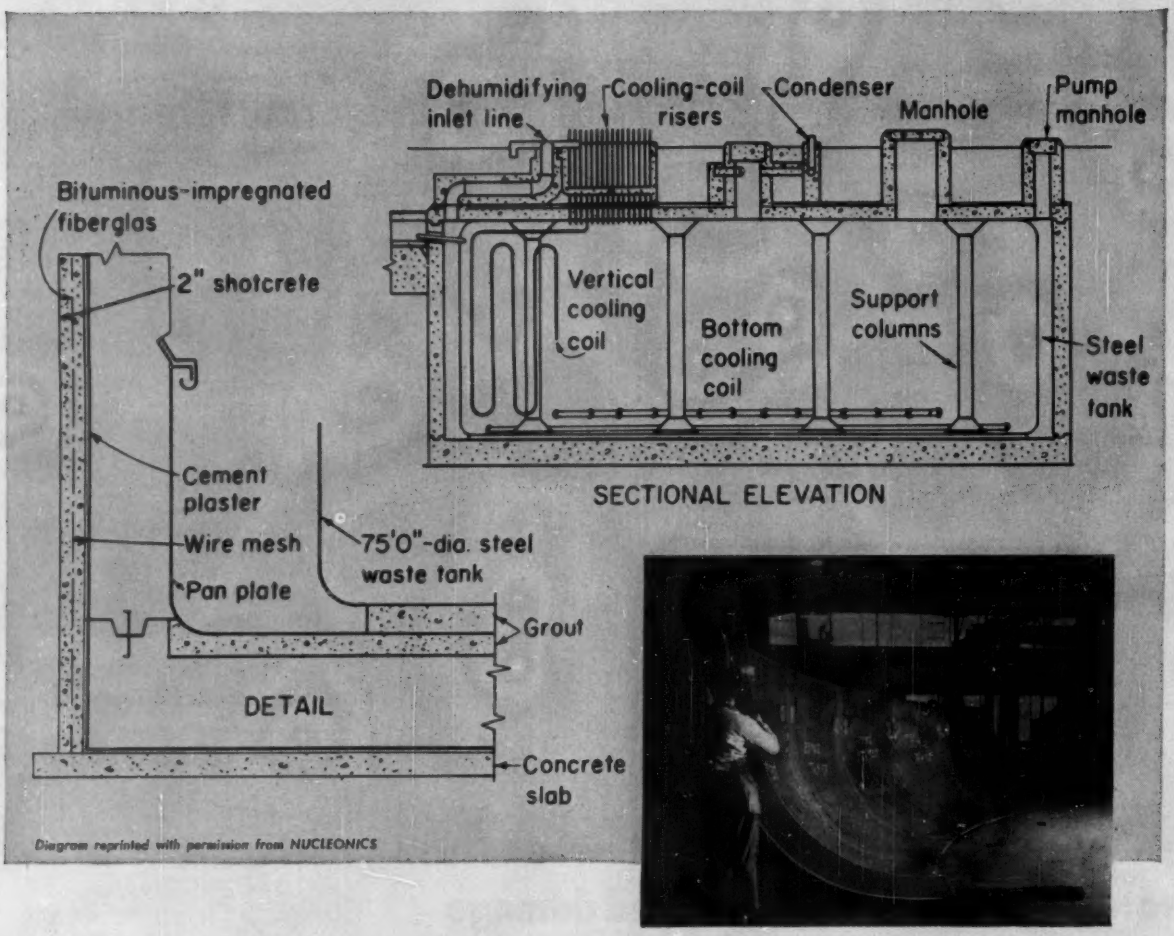
THE FALK CORPORATION, MILWAUKEE 1, WISCONSIN

MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS

Representatives and Distributors in many principal cities.

FALK

...a good name in industry



One AEC Solution To Radioactive Waste Storage

Storing radioactive wastes underground in huge 750,000 gallon double-bottomed steel tanks, as shown above, is one solution to the waste disposal problem at the AEC installations at Savannah River, S. C. and Hanford, Wash. Internal cooling coils take away the heat generated by radioactive decay. Remote handling protects personnel from high activity levels.

Graver has fabricated and erected sixty-eight such waste storage tanks for these nuclear installations. Special fabricating methods and field-erection techniques were required. For example, shop fit-up of the curved bottom plates expedited field assembly of the tanks.

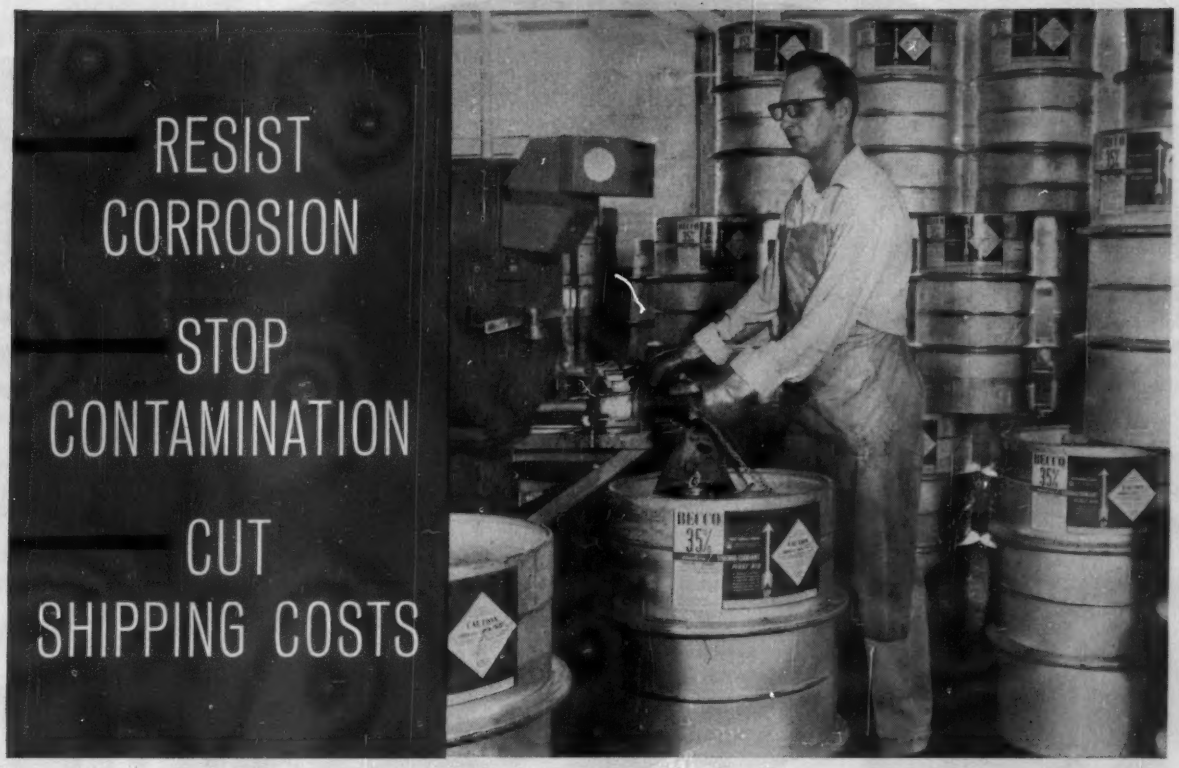
The century-long experience of Graver in fabricating steels and alloys for a huge variety of processing equipment, pressure vessels and storage tanks admirably qualifies it to build for the future with America's important nuclear industry.

GRAVER

Building for the Future on a Century of Craftsmanship in Steels and Alloys

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA • New York • Philadelphia
Edge Moor, Delaware • Pittsburgh • Atlanta • Detroit • Chicago
Tulsa • Sand Springs, Oklahoma • Houston • New Orleans
Los Angeles • Fontana, California • San Francisco



...Benson Aluminum Drums

Shipping can cover a multitude of costs. You have to consider the maintenance and replacement costs of the container, possible contamination of the product shipped—and weight of the whole package.

These are all sound reasons for using Benson Aluminum Drums to ship chemicals, corrosives and liquids that must not be contaminated. And, these are the main reasons Becco Chemical Division, Food Machinery and Chemical Corp., uses these light, strong, corrosion-resisting drums to ship hydrogen peroxide.

Aluminum won't contaminate the fluids it handles; it needs no coating; it resists corrosion. It's light and strong.

This means lower maintenance costs, longer life, less spoilage — and lower shipping and handling costs.

Learn how Benson Aluminum Drums can cut your shipping costs, too. Call your local Reynolds branch office, or write *Reynolds Metals Company, P.O. Box 2346-CJ, Richmond 18, Virginia.*

The Finest Products Made with Aluminum are made with REYNOLDS ALUMINUM

Watch Reynolds All-Family Television Program, "DISNEYLAND", ABC-TV.

REYNOLDS ALUMINUM

It's the Nash!

The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintain 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

Nash Compressors have no valves, gears, pistons, sliding vanes or other enemies of long life. Compression is secured by an entirely different principle of operation, which offers important advantages often the answer to gas handling problems difficult with ordinary equipment.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

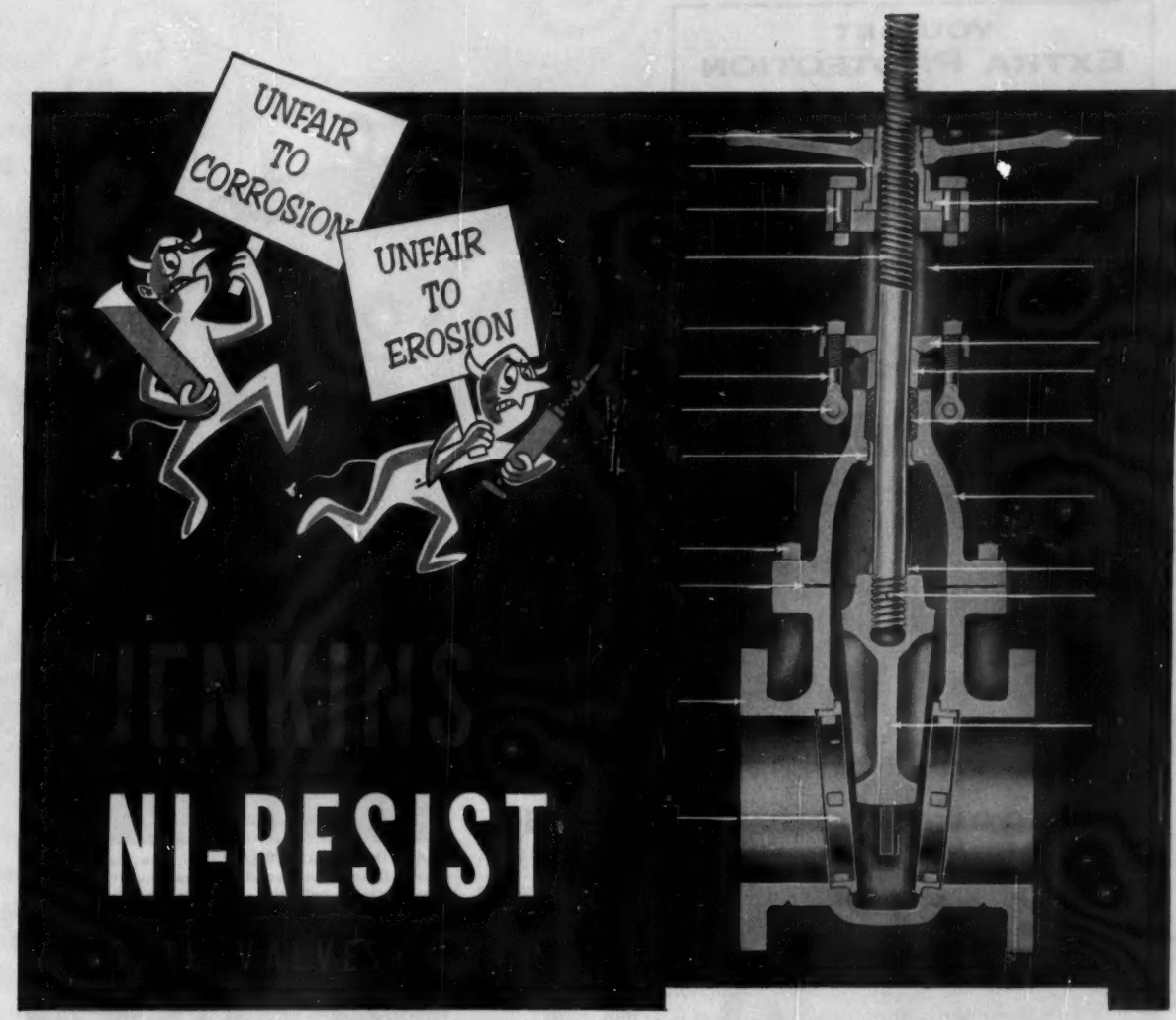
Desired delivery temperature Automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

312 WILSON, SO. NORWALK, CONN.



Wherever valves are attacked by acids, salt and alkaline solutions, sea water, brine or other corrosive fluids, vapors or gases, "Jenkins Ni-Resist Gate Valves" are *fighting* words.

In a wide range of corrosive and erosive services common to the chemical, food, plastics, marine, petroleum, and pulp and paper industries, these valves have shown a remarkable ability to withstand corrosion and cut valve costs.

The secret of their long, trouble-free service is the combination of Ni-Resist type 2 cast iron and type 316 stainless steel trim, plus Jenkins *extra value* construction throughout. No other gate valves offer this combination for fighting corrosion.

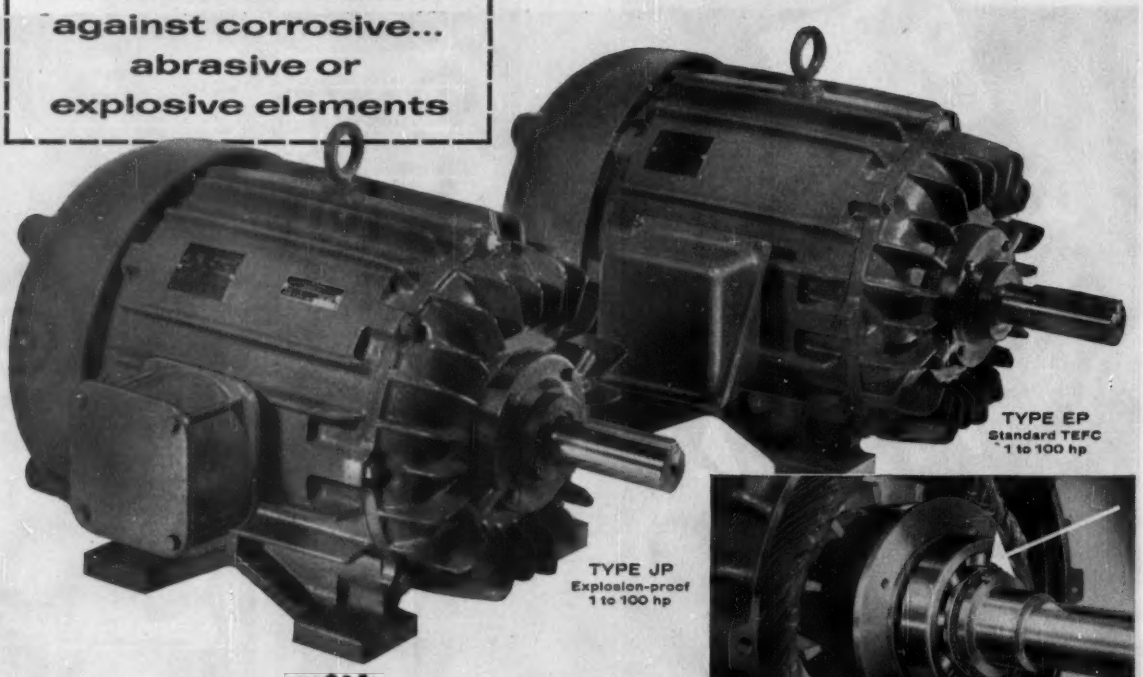
When choosing Ni-Resist valves, let the famous Jenkins Diamond be your guide. Specify "JENKINS NI-RESIST" — for longer valve life. Write us, or ask your Jenkins Distributor for information folder No. 205. Jenkins Bros., 100 Park Avenue, New York 17.

A Bronze yoke bushing nut
B Handy grip iron wheel
C Bronze yoke bushing
D Iron yoke cap with zerk fitting for lubricating bushing
E Steel yoke cap bolts and nuts
F TYPE 316 STAINLESS STEEL spindle
G NI-RESIST CAST IRON, TYPE 2, yoke
H Bronze eye bolt nuts
I Malleable iron gland flange
J Steel gland eye bolts
K Steel gland lug bolts and nuts
L TYPE 316 STAINLESS STEEL gland
M Teflon impregnated asbestos packing
N TYPE 316 STAINLESS STEEL bonnet bushing
O NI-RESIST CAST IRON, TYPE 2, bonnet
P Steel bonnet bolts and nuts
Q TYPE 316 STAINLESS STEEL spindle ring
R Asbestos gasket
S TYPE 316 STAINLESS STEEL wedge pin
T NI-RESIST CAST IRON, TYPE 2, through-port body
U TYPE 316 STAINLESS STEEL solid I-beam wedge
V TYPE 316 STAINLESS STEEL seat rings

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS
SINCE 1864

Sold Through Leading Distributors Everywhere

YOU GET
EXTRA PROTECTION
against corrosive...
abrasive or
explosive elements



TYPE EP
Standard TEFC
1 to 100 hp

TYPE JP
Explosion-proof
1 to 100 hp

with

Wagner totally enclosed motors...protected for longer motor life

If you need motors that will keep production rates up . . . that will give the continuity of service that is so important to automation . . . that will operate with complete dependability under the most severe conditions—Wagner totally-enclosed motors are your soundest choice.

Type EP Motors offer protection against corrosion, dust, abrasives, fumes, steel chips or filings. Type JP is explosion proof as well—designed and approved for use in explosive atmospheres.

NEW NEMA FRAMES . . . These motors are built in the new NEMA Frame sizes from 182 through 445U, with ribs that add mechanical strength and increase the surface cooling area. Effective cooling system adds to motor life. Let your Wagner Sales Engineer show you how these protected motors can bring you savings on initial motor costs, maintenance costs and continuity of operation.

1 TO 100 HP—4 POLE, 60 CYCLE—
NEMA FRAMES 182 THROUGH 445U

Wagner Electric Corporation
6407 Plymouth Ave., St. Louis 14, Missouri.

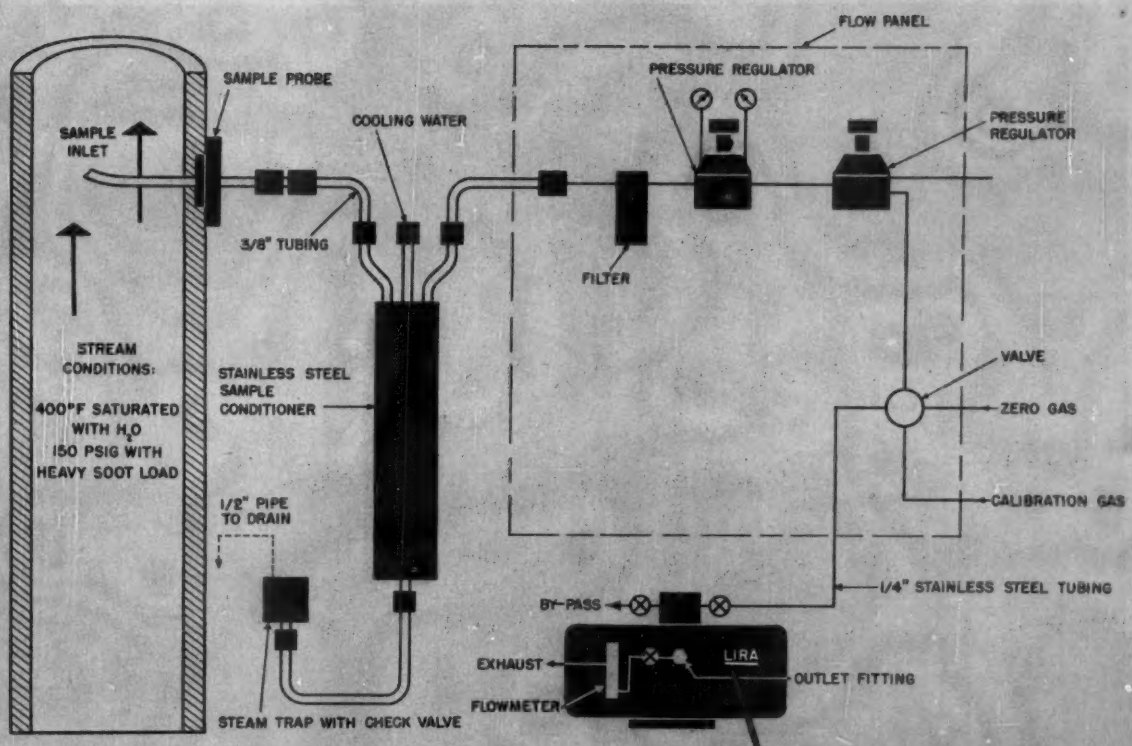
WH58-5

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

HEAVY DUTY BALL BEARINGS . . . The ball bearings used in these motors are of the highest quality, with more than ample capacity to provide long troublefree service under heavy loads.

BEARINGS CAN BE RELUBRICATED . . . Factory installation will last for many years under normal service, but openings are provided to permit relubrication that adds years to motor life under severe conditions.

SEALS KEEP BEARINGS CLEAN . . . Both ends of these motors have running shaft seals to keep the bearings clean. Bearing housings are effectively sealed to prevent escape of grease.



Explosion-proof Model 200 LIRA has a tamper-proof lock. All self-checking circuit controls are easily accessible through the explosion-proof enclosure.

Another MSA-ENGINEERED SAMPLE SYSTEM for safe, reliable gas analysis with LIRA analyzers:

sampling residual methane, carbon dioxide and carbon monoxide in synthetic ammonia plants

M-S-A® LIRA Infra-Red Analyzers perform two vital functions in ammonia synthesis-gas preparation facilities. They make possible instant diagnosis of operating difficulties and rapid adjustment during plant start-up. Savings involved quickly amortize the cost of the analyzer.

By monitoring methane, carbon monoxide and carbon dioxide content of hydrogen-nitrogen make-up streams, you can maintain a thorough check on gas purification operations. And the streamlined way to do it — with utmost process efficiency — is with continuous infra-red analysis. More specifically: M-S-A LIRA Analyzers.

Speaking now of applications, one of the really tough problems is analyzing the methane in the process gas immediately after the reformers. The gas stream is dirty. It is saturated with steam at high temperature and pressure. But the methane has to be measured to determine the reaction efficiency. This measurement enables the operator to adjust the process when reactor temperature or changes in the raw feed stock cause variations in methane content.

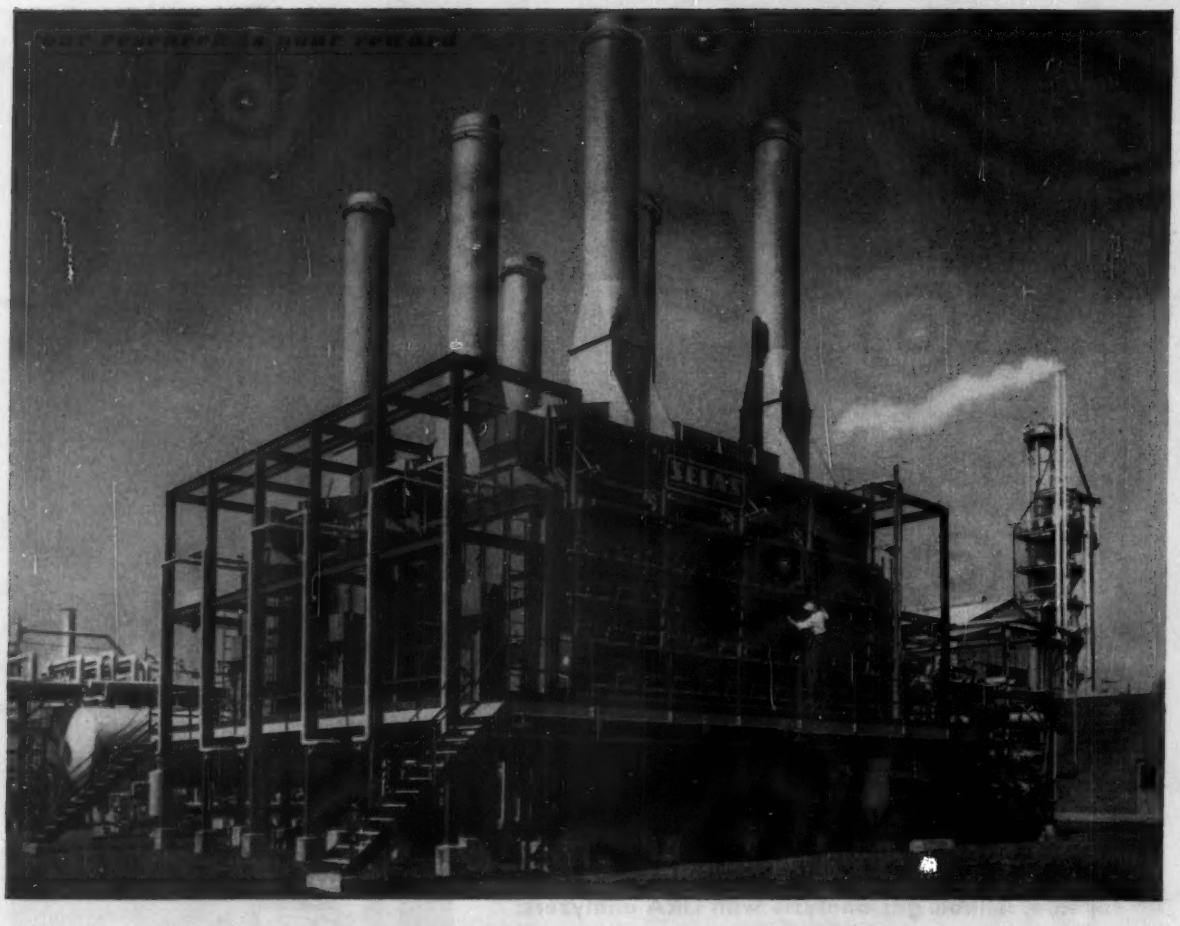
The LIRA does this measuring job to a faretheewell. Automatically. Continuously. Safely. Accurately. Inexpensively.

In the field of gas analysis — you name the gas — MSA has been coming to grips with similar process problems for over 30 years. We'd like to lay that 30 years on the line and let it work to your advantage. Ask the MSA Instrument Specialist to call. And write us for the M-S-A LIRA bulletin.

INSTRUMENT DIVISION

MSA

Mine Safety Appliances Company
Pittsburgh 8, Pennsylvania



55 heaters in ethylene service

prove the extra benefits of Selas Gradiation® processing

The difficulty in heat processing light hydrocarbons for ethylene production in conventional tubular heaters is to achieve uniform application of heat on the tube wall. Flame impingement or excessive heat on one side of the tube outer wall hastens metal degradation and, especially with highly corrosive feed stocks, tube corrosion.

Selas Gradiation overcomes that difficulty by distributing radiant heat uniformly along and around the entire tube wall, minimizing scaling and corrosion. Maximum allowable heat rate may thus be used in establishing coil length. The result: shorter lengths of tubes, fewer tubes, more compact furnaces. Obviously, tube replacement — when required — is less costly.

Selas heaters in ethylene service in 22 installations throughout the world are designed to process a variety of feed stocks interchangeably. Burners are individually adjustable. Response to controller demands is split-second. This quality of Zone Control makes Selas heaters exceptionally versatile; makes them, as one processor has said: "The heart of the refinery."

Selas Gradiation heaters for the chemical, petrochemical and petroleum industries may be field-erected or shop-assembled. Selas also builds Econotherm* heaters for use where materials are heated to below decomposition temperatures.

Send for reprint "Try the Gradiation Heater for Economic Ethylene Production" and Bulletin 1411 "Gradiation Heating for Petroleum and Chemical Processing." Selas engineers will be glad to discuss your heat-processing requirements with you. Selas Corporation of America, Dresher, Pa.

Gradiation is a registered trade name of Selas Corporation of America. *Trade Name

SELAS
CORPORATION OF AMERICA
DRESHER, PENNSYLVANIA

Heat and Fluid Processing Engineers

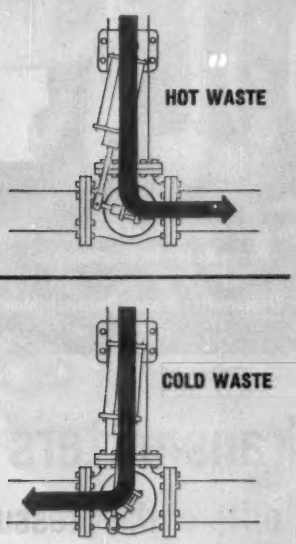
DEVELOPMENT • DESIGN • CONSTRUCTION

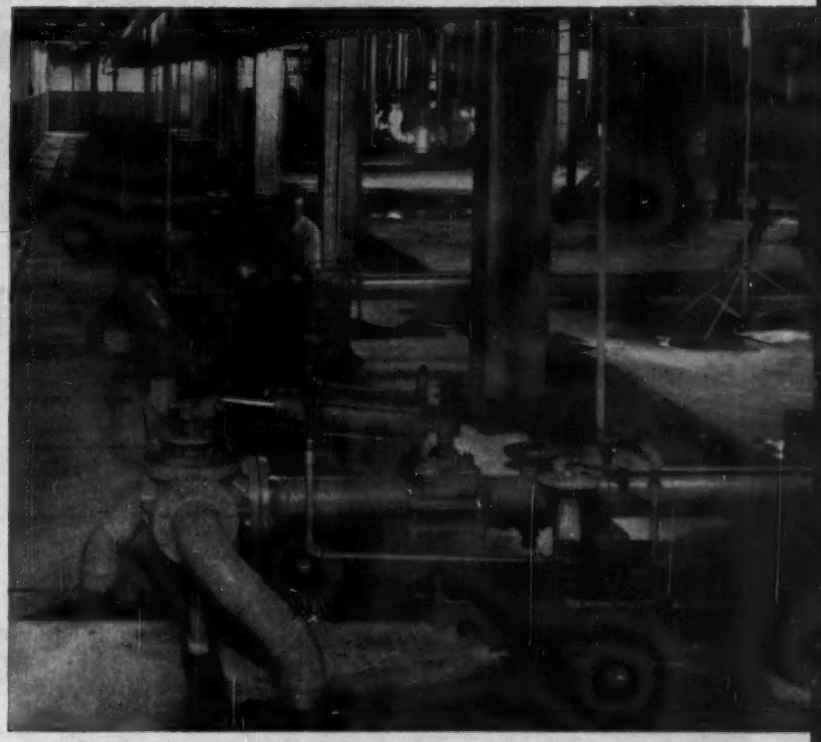
SUBSIDIARIES: Selas Constructors, Inc., Houston, Texas; Selas Corporation of America, European Div., S. A., Pregny, Geneva, Switzerland.
INTERNATIONAL REPRESENTATIVES AND LICENSEES: CAMBODIA, FORMOSA, KOREA, LAOS, VIETNAM—Casa Export Co., Inc.; JAPAN—International Machine Co., Ltd., Tokyo; COLOMBIA, VENEZUELA—Intertec, C.A., Caracas; GERMANY—Ernst Kirchner, Hamburg; FRANCE—Societe Exploitation de Produits Industriels, Paris; ITALY—Societa Italiana E. Kirchner, S.r.l., Milano; BENELUX, PORTUGAL, SPAIN—Union Chimique, Brussels.

How would you solve this problem?

Problem: Waste from a process unit varied in temperature with the process cycle. How would you control the waste flow to utilize hot waste and cold waste in heat exchangers in other parts of the plant?

Solution: Rockwell-Nordstrom 3-way Multiport valves (see below) were equipped with thermostatically controlled air cylinder actuators. As the temperature of the waste in the valve inlet line changes, the thermostat "tells" the cylinder to move the valve plug and automatically shunt the hot waste into one inlet line or the cooled waste into the other outlet line. *One valve does the job of at least three!*





Rockwell-Nordstrom Multiport valves are used in the process industries where 3-way and 4-way flow control is needed through one valve. They greatly simplify flow control and reduce cost by eliminating unnecessary piping and valves.

Rockwell-Nordstrom is the world's most complete line of lubricated plug valves—both Multiport and Straightway. Available in semi-steel, steel, stainless, Monel, Bronze and other corrosion-resisting alloys in sizes from ½" to 30" to meet every process valve need. For details, write: Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES

it's **ROCKWELL**

MANUFACTURING COMPANY

Send Coupon For Free Literature

Rockwell Manufacturing Company
Rockwell-Nordstrom Valve Division
Department CE Pittsburgh 8, Pa.

☐ Please send me complete information on Rockwell-Nordstrom valves for process, industrial and manufacturing flow control.

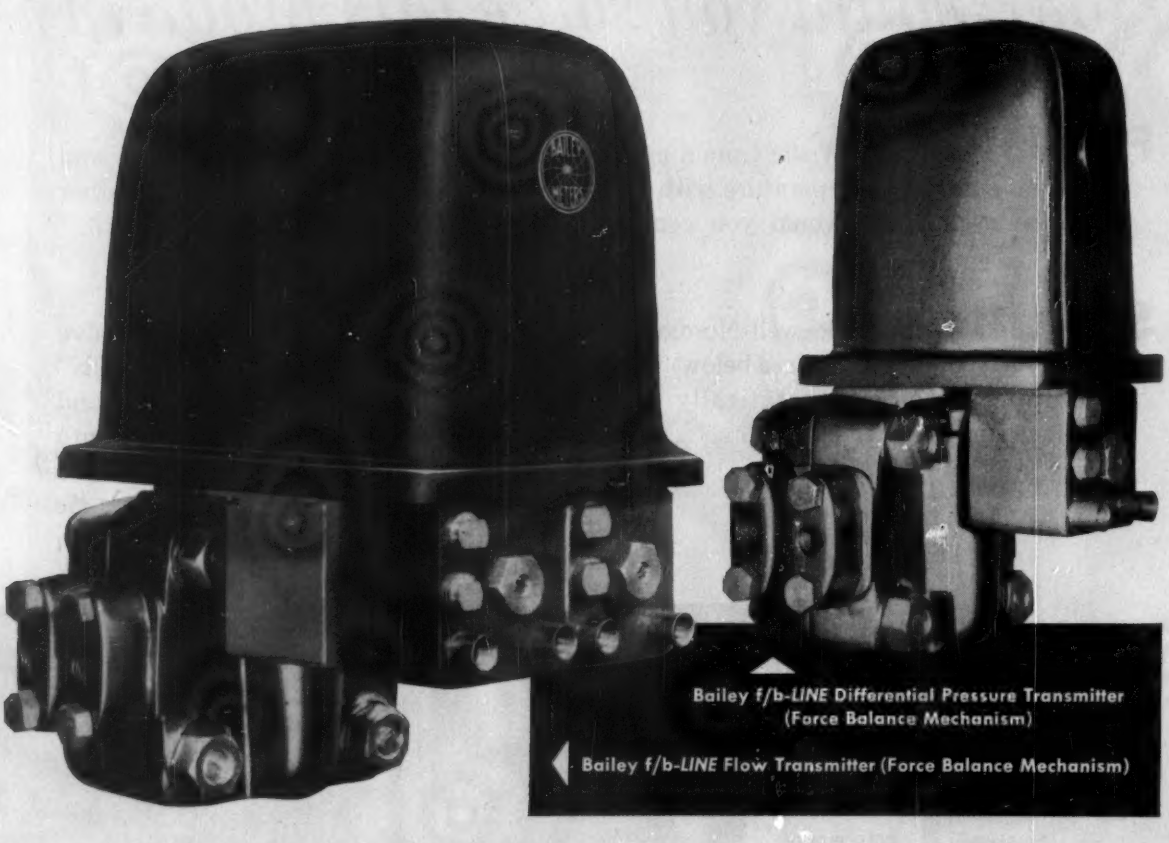
☐ Please send me the name of your nearest distributor . . . ask him (to) (not to) call immediately.

Name_____ Title_____

Firm_____

Street_____

City_____ Zone_____ State_____



Bailey f/b-*LINE* Differential Pressure Transmitter (Force Balance Mechanism)

Bailey f/b-*LINE* Flow Transmitter (Force Balance Mechanism)

Two new Bailey *f/b-LINE* Transmitters

permit new accuracy in measuring flow and differential pressure

Pneumatically transmits rate of flow—or differential pressure—measurements to indicating, recording, and/or controlling equipment at remote stations. Transmitters consist of a diaphragm measuring mechanism and a force balance pneumatic transmitting unit.

APPLICATION

For steam, water, air, gases and other fluids producing differentials across primary elements from 0-2 in. H_2O to 0-2000 in. H_2O at maximum service pressure of 50, 1500, and 5000 psig.

FEATURES

Transmits a Signal Directly Proportional to Rate of Flow. Uses receiver with uniformly-graduated chart or scale. Eliminates need for external square-root extractors or characterizers.

10 to 1 Turndown. Differential range of each diaphragm measuring element may be changed by factor of 10 to 1; e.g., 0-20 in. H_2O diaphragm may also measure 0-2 in. H_2O.

Screwdriver Adjustments. Range and zero adjustments readily accessible. Range may be changed with screwdriver adjustment.

Overpressure Protection. Protects against full service pressure applied to either side of diaphragm.

Fast Response. No viscous dampers needed, so speed of response is very fast.

Corrosion Resistant. For maximum differentials between 20 and 2000" H_2O, all parts in contact with process fluid may be stainless steel. No sealing fluids or sealing diaphragm required.

Good Stability. Reset type boosters give good stability with high gain.

Versatile Mounting. May be mounted on process piping, wall, or separate mounting pipe using same bracket.

For additional information, call your local Bailey District Office, or write direct.

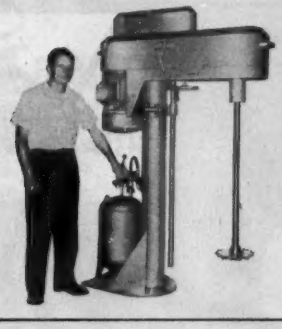
CP4-1

Chemical and petroleum division

BAILEY METER COMPANY

1054 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal



In the Cowles...

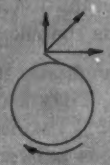
IT'S THE TEETH THAT MAKE THE DIFFERENCE

for greater mixing volume and quality

That's why the Cowles Dissolver is most in demand for ultimate dispersion, dissolving, emulsifying and deagglomerating—in processing solid-liquid, liquid-liquid and gas-liquid materials.

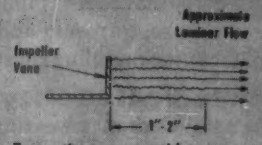
These teeth are an exclusive, patented feature of the Cowles Impeller. They set the Cowles far ahead of conventional mixers. Scientifically engineered power and drive systems insure complete control of the impeller action. The result is shown here in the steps that give you "MULTI-PHASE" mixing for greater volume and finer quality.

1. Imparts high velocity to material.



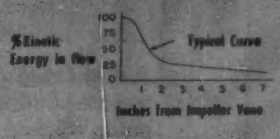
3000-6000 F.P.M. in production models

2. Creates zone of intense turbulence.



Two actions cause rapid hydraulic attrition in this zone: Shear—Rubbing of particles on each other and scrubbing of liquid phase on surfaces of solid phase. Impact—Particle collisions due to directional differentials.

3. Concentrates energy close to impeller.



The turbulent zone is a zone of intense energy dissipation. Nearly 75% of the kinetic energy is used for hydraulic attrition in a distance of 1"-2" from the impeller vanes.

4. Causes laminar flow for "Total Motion"

Beyond the turbulent zone the movement becomes laminar. This flow divides at the vessel wall assuring complete circulation of the entire batch. Turbulence does not interrupt flow pattern.

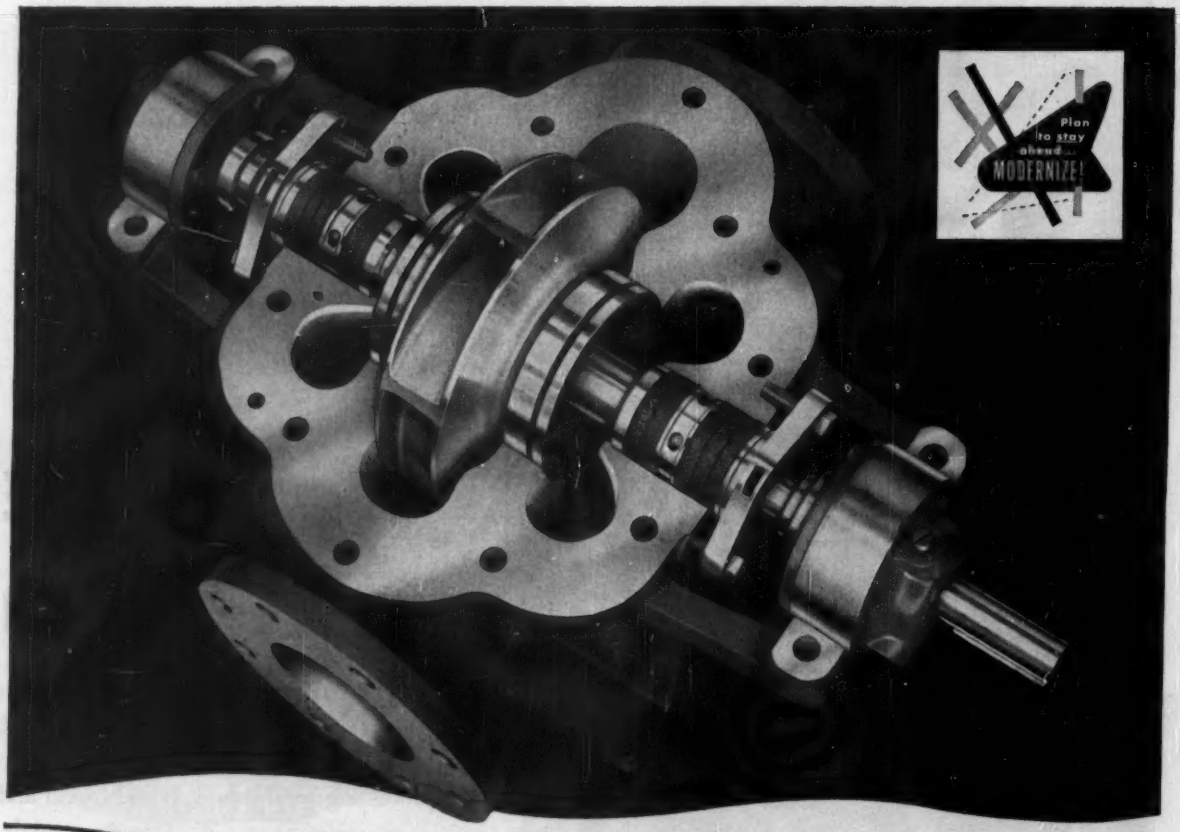
EE05

MOREHOUSE COWLES

The Cowles is adaptable to your materials, processes and present equipment. Cowles engineers will be happy to work with you in solving your processing problems economically. Their solutions are based on the industry's most advanced research. Let us prove it in your plant at our risk! Write today for complete information and catalog.

Representatives in principal cities
Convenient lease and time payment plans

MOREHOUSE-COWLES 1150 San Fernando Rd., Los Angeles 65, Calif.



Here's extra dependability

for pumping most ANY flowing liquid

Bronze, nodular iron, stainless steel, high nickel alloys — in fact, all metals that can be cast and machined — are available in Allis-Chalmers single-stage, double-suction pumps.

This material availability makes A-C pumps exactly *right* for *your* problems of temperature, corrosion and contamination... makes them extra-reliable for pumping most liquids that flow.

Adding to this reliability is the optional feature of adjustable axial-clearance wearing rings. They keep pump efficiency high . . . have saved as much as 75% maintenance and replacement costs. Too, axial clearances prevent jamming. Another optional feature — mechanical seals — can be furnished.

These Pumps

are offered in a wide variety of sizes from 1½" to 72" with capacities to 225,000 gpm, heads to 600 feet. Contact your A-C office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-5854

"Used many makes of turbines... PREFERS COPPUS"

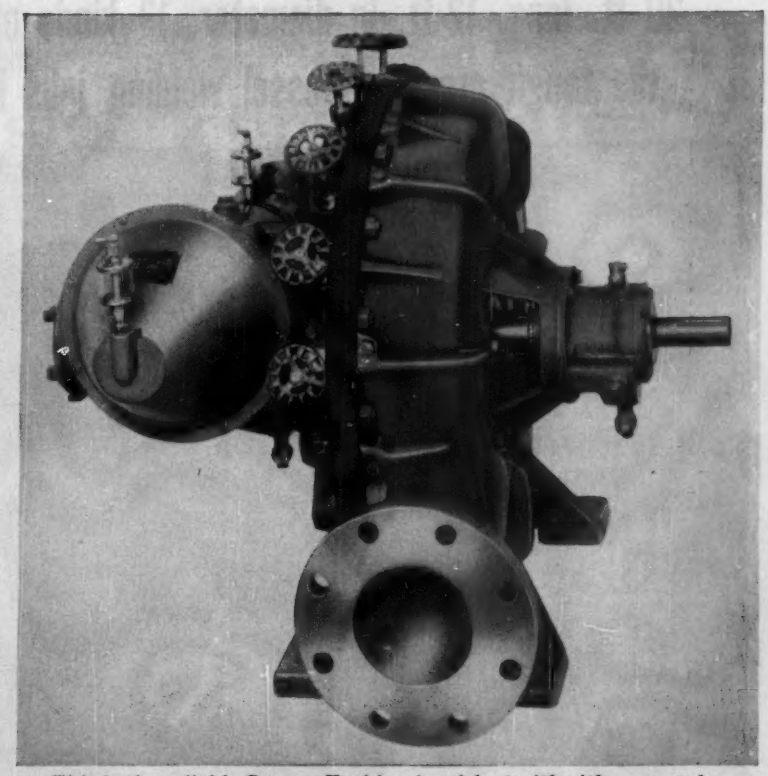
If you want to know about turbine performance, ask an *operator*. He *knows*. And, in the words of one of them:

> "I have had occasion in the past to operate many makes of turbines. The plant in which I am now employed is almost entirely Coppus equipped on our auxiliary equipment. I find your turbines most satisfactory and would like to congratulate you on your design."

Whether you use a Coppus with a regular wheel or wide bucket "L" type you get these *proven* features:

- Turbines rated close to your hp requirements from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.
- Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbine.

COPPUS ENGINEERING CORPORATION
232 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER



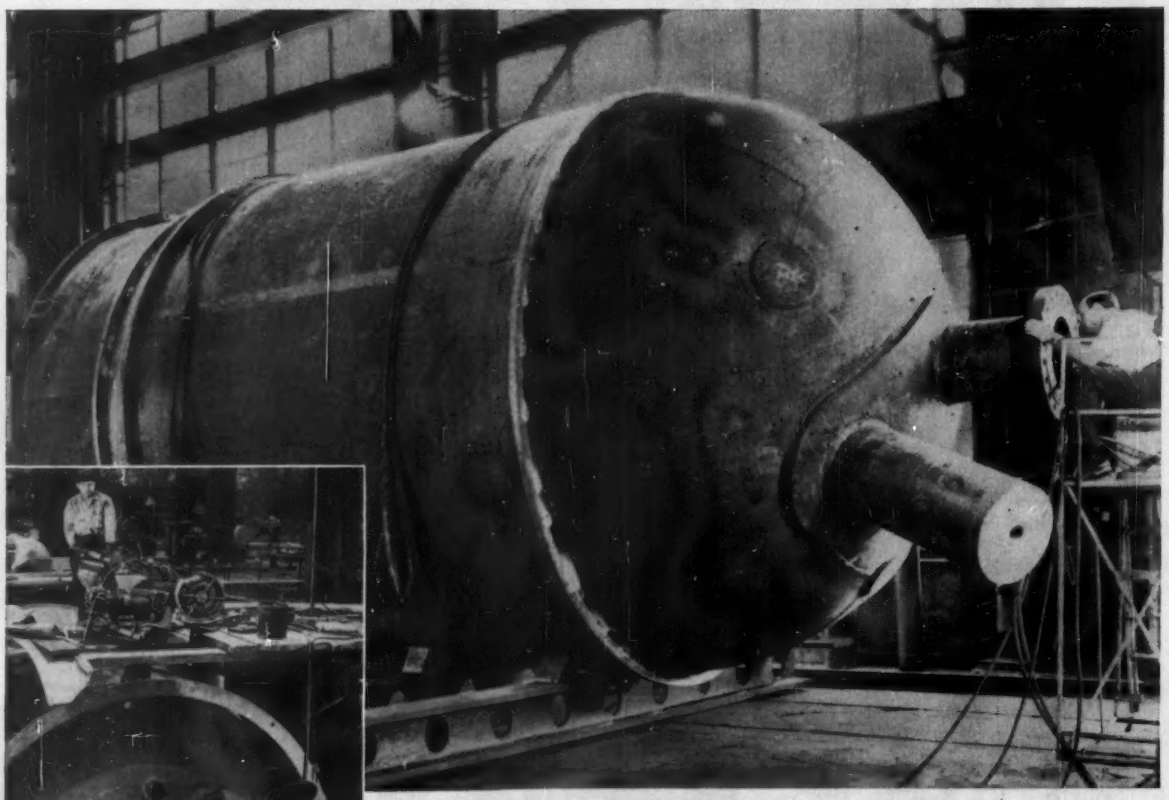
This is the reliable Coppus Turbine furnished with either a regular wheel or wide bucket "L" type wheel.

This wide bucket "L" type wheel is a new development for use where low water rate is essential

This is the regular wheel used on Coppus Turbines which have been so highly satisfactory throughout industry.

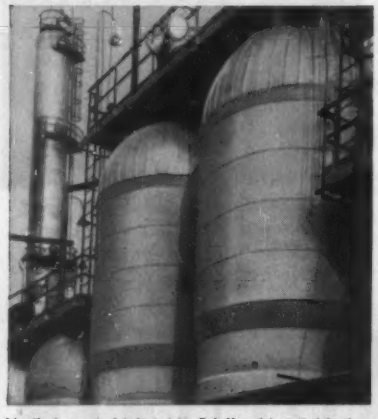
COPPUS "BLUE RIBBON" TURBINES

20 ft. long, 12 ft. in diameter, 13 kinds of steel . . . typical of the tough pressure vessel welding jobs Baldwin is noted for



Built by B-L-H's Eddystone Division, a 100-ton pressure vessel made chiefly of chrome molybdenum steel is here shown being inspected by an Eddystone engineer.

Automatic submerged metal arc was one of three welding methods employed on this huge pressure vessel.



Identical vessels fabricated by B-L-H and installed in the catalytic reforming unit of an ultramodern refinery.

A major oil company recently called on Baldwin-Lima-Hamilton's Eddystone Division to weld two identical 100-ton pressure vessels that must operate continuously for long periods of time at nearly 1000°F in a hydrogen-rich atmosphere at pressures up to 536 psi. Baldwin successfully met the challenge of this big job.

Thirteen different kinds of steel ⅜ in. to 5⅛ in. thick and three welding methods—manual-shielded metal arc, automatic submerged metal arc, and inert gas—had to be used on the vessels, each 20 ft. long, 12 ft. in diameter. As on all Baldwin work, only qualified welders were used.

Radiographic inspection of all welds revealed no defects. After the vessels were hydrostatically tested at 1575 psi for 3 hours, all seams were examined for leaks and found to be tight.

For a copy of our illustrated Weldment Bulletin 7001 or for specific information on how we may be of service to you, write to B-L-H Corporation, Philadelphia 42, Pa.

BALDWIN · LIMA · HAMILTON

Eddystone Division

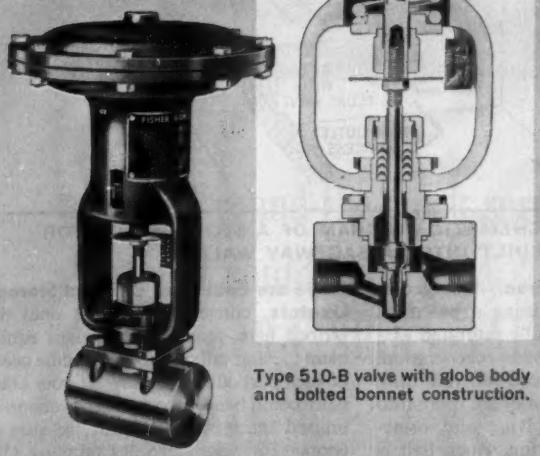
Philadelphia 42, Pa.

Hydraulic turbines • Weldments • Dump cars • Nonferrous castings • Special machinery • Bending rolls • Machine tools

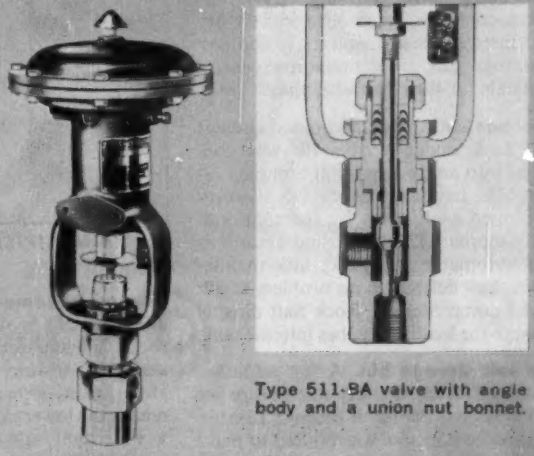
"Hand size" control valve for all corrosive applications

- **Inexpensive and highly dependable.**
- **Available in globe or angle body single port construction.**

Fisher now offers the low cost, dependable "BA" angle body and the "B" globe body valves for use on heavy duty applications involving corrosive liquids. Bodies are machined from 316 stainless steel bar stock, or other alloys such as Monel or Hastelloy. Either body can be supplied with Type 510 spring open or Type 511 spring closed diaphragm actuator. Normal diaphragm range 3 to 15 psi.



Type 510-B valve with globe body and bolted bonnet construction.



Type 511-BA valve with angle body and a union nut bonnet.

CONSTRUCTION AND SPECIFICATIONS	
Valve Body Sizes	½", ¾" and 1" only with screwed end connections.
Inner Valve	Micro-flute or Micro-form.
Orifice Sizes	¼", ⅜", ½" and ¾" for the 1" size body. ¼", ⅜" and ½" for the ¾" size body. ¼" and ⅜" for the ½" size body.
Max. Body Pressure	1500 psi at 450° F.
Overall Dimension	Approximately 15" with the Type 510 or Type 511 topwork on either a "B" or "BA" body.

For complete information write for Bulletin 57 B.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / London, England

CONTINENTAL EQUIPMENT CO. DIVISION, Coraopolis, Pennsylvania

FISHER

SINCE 1880

Using Salt Efficiently

by INTERNATIONAL SALT COMPANY, INC.

Making Automatic Salt Dissolvers from Existing Plant Equipment

A great many industrial companies and public institutions are now enjoying the benefits of pure, fully saturated rock-salt brine at remarkably little cost. They have found that expensive new equipment is not needed to make this brine! Instead, International has shown them how to convert unused or unproductive plant equipment into salt dissolvers that operate under the Lixate Brine-Making Process.

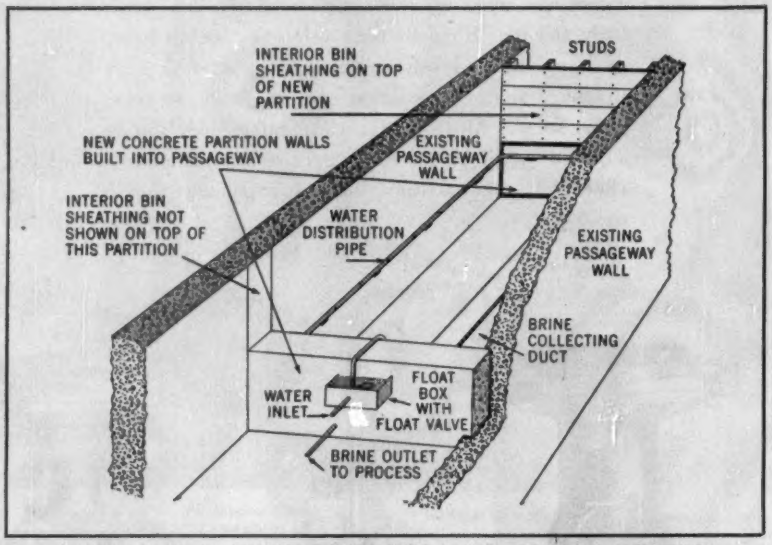
Here are four typical examples from the scores of special salt dissolvers that have been made from unused storage rooms, coal silos, locomotive tenders, dry salt bins, etc. These dissolvers, in addition to saving space, did not require expensive materials for their "construction."

Steel gas tank. Here, an unused circular steel tank under a sidewalk was converted into an underground Storage Lixator. (The Lixator is a rock-salt dissolver developed exclusively by International Salt Company.) This unusual Lixator is fully automatic, needs very little maintenance. Salt delivery is no problem at all: trucks dump Sterling Rock Salt directly through the loading hatches into the tank.

Dry salt storage bin. A few additions converted an existing dry salt storage bin into a rugged dual-unit Storage Lixator. Reinforced concrete was poured to make two 6-ft.-high salt-dissolving tanks in the bottom of the bin. Water inlet and brine discharge pipes, plus a few other necessary pieces of equipment, were installed . . . and the Lixator was ready to operate.

THE LIXATE PROCESS

. . . for making brine works like this: Sterling Rock Salt is stored in a tank called a Lixator. Water is admitted near the top. It flows *down*, dissolving salt as it goes. Soon fully saturated and unable to absorb more salt, this brine is completely self-filtered by the salt crystals in the bottom of the tank. The resulting Lixate Brine is exceptionally pure, clean, high in quality. As this brine is drawn off to points of use, more Sterling Rock Salt flows into the Lixator, and more water is admitted to produce more brine.



SIMPLIFIED SCHEMATIC DIAGRAM OF A STORAGE LIXATOR BUILT INTO PASSAGEWAY WALLS

Unused basement area. A large industrial plant is now using a basement room to make clean, fully saturated Lixate Brine for water-softener regeneration. Here again, a reinforced-concrete tank makes the lower portion of the room into a watertight salt-dissolving and brine-storage unit. Dry Sterling Rock Salt is stored in the space above the salt-dissolving tank, and in the room directly over the Lixator.

Underneath a railroad trestle. One of the most dramatic Lixator installations is the conversion of the empty space under a railroad trestle. 70 ft. long, 18 ft. wide, and 12 ft. high, this extraordinary Storage Lixator can make thousands of gallons of Lixate Brine per hour. And salt delivery is entirely automatic: Sterling Rock Salt drops *directly* from railroad hopper cars on the trestle into the Lixator.

There are dozens of different Storage Lixators, converted, like the ones described here, from existing plant equipment . . . and tailored to the specific needs of each particular company. If your company could benefit from the conversion of unused space into a Lixator, be sure to contact International Salt Company. One of our experienced sales engineers can show you detailed plans of existing Lixators. He can also work with you to decide on the installation that will best meet your requirements.

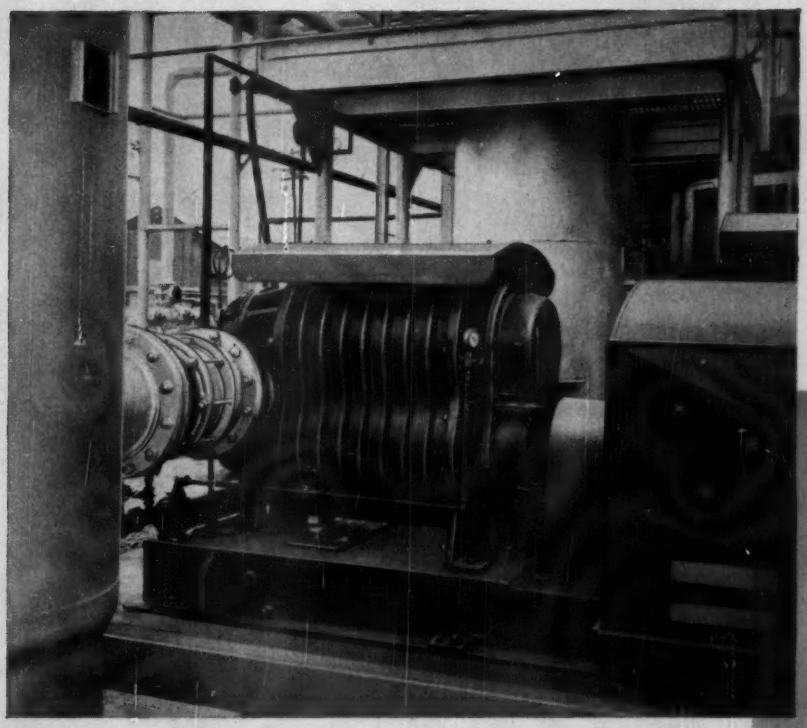
To get this impartial technical assistance, contact your nearest International sales office, or write to us direct.

INTERNATIONAL SALT CO., SCRANTON, PA.
Sales Offices: Atlanta, Ga.; Chicago, Ill.; New Orleans, La.; Baltimore, Md.; Boston, Mass.; Detroit, Mich.; St. Louis, Mo.; Newark, N. J.; Buffalo, N. Y.; New York, N. Y.; Cincinnati, O.; Cleveland, O.; Philadelphia, Pa.; Pittsburgh, Pa.; Memphis, Tenn.; and Richmond, Va.

Service and research are the extras in **STERLING SALT**
PRODUCT OF INTERNATIONAL SALT COMPANY, INC.

AT KERR-McGEE OIL INDUSTRIES REFINERY

KERR-McGEE



14 x 27 Spiraxial Compressor delivers 3456 cfm at 28 psi discharge operating at 1800 RPM requiring 450 HP.

- Sized for direct-connected drives with motors, engines or turbines, at speeds from 1,750 to 3,550 RPM.
- Peak efficiencies at required discharge pressures.
- Uncooled — requires no water jacketing.
- No internal lubrication — delivers oil-free air.
- Small space — low noise level.
- Capacity ratings range from 700 cfm to 5,000 cfm, with pressures from 8 psi to 30 psi.

Rugged round-the-clock service without shutdown... thanks to R-C SPIRAXIAL® COMPRESSOR

The Cushing, Okla. Refinery of Kerr-McGee Oil Industries recently installed this 14 by 27 R-C Spiraxial Compressor and ran it for six months on a rugged 24 hour a day schedule—*without shut down or difficulties of any kind!*

The unit supplements the air supply to the regenerator and has helped increase throughput by 550 bbls. per day. Thus only a 1-year's run will pay for the installation!

Such sturdy, dollar-wise performance is typical of R-C Spiraxial units for refinery and many other types of service. Engineered with R-C patented Rotor Design, they insure greater efficiency, dependability and economy . . . require no water jacketing . . . reduce substantially both first cost *and* maintenance. Variable compression ratios widen the range of uses. Absence of internal lubrication assures oil-free air.

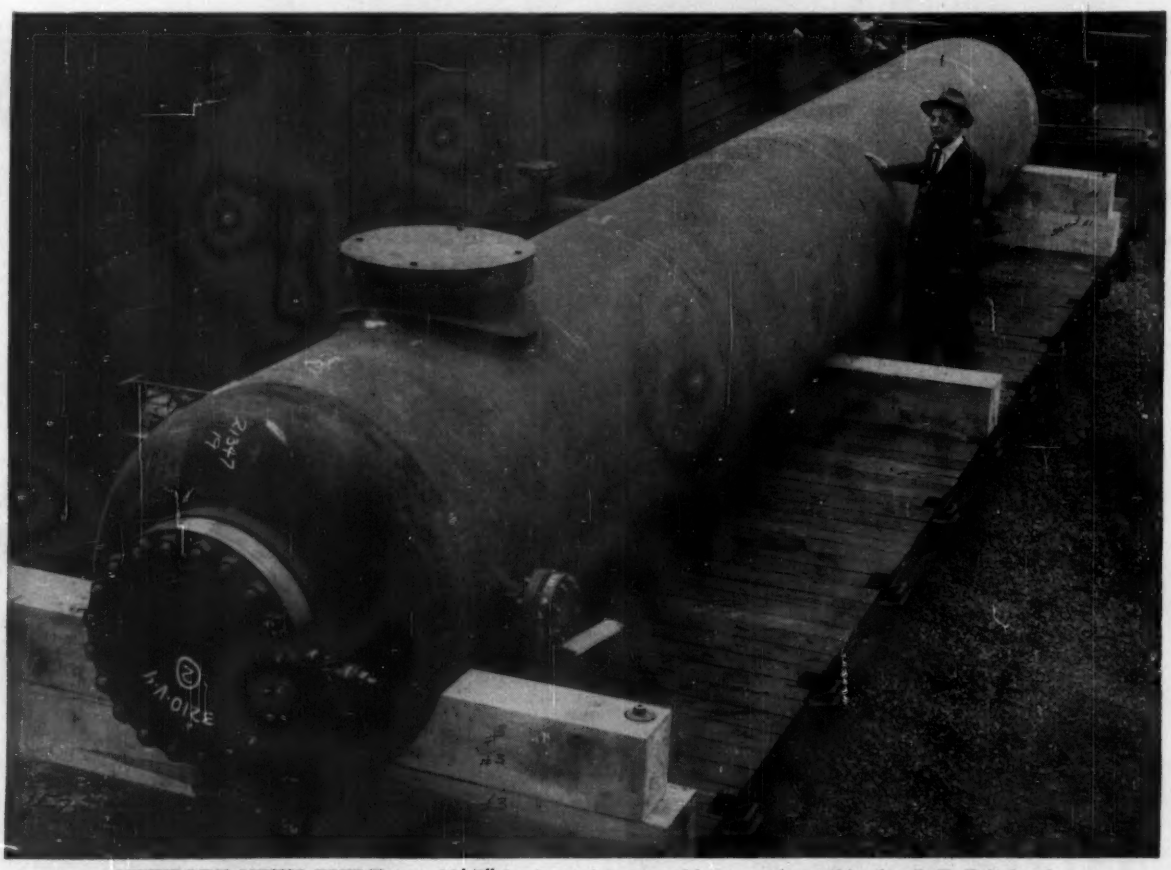
A product of progressive engineering, R-C Spiraxial Compressors are built to the same high standards of manufacture that have made Roots-Connersville the symbol of compressor dependability throughout the world.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

1158 Illinois Ave., Connersville, Indiana In Canada—629 Adelaide St., W., Toronto, Ont.

For additional data, please refer to our section in Chemical Engineering Catalog or Mechanical Catalog or write for Bulletin LAL-458.



NEWPORT NEWS BUILT two 39'-7" horizontal gas scrubbers, such as this, for J. F. Pritchard & Co. They were made of ASTM-A212 Grade B fire box steel, with structural mesh steel interiors.

Gas scrubber made of 2⅞" steel

Newport News builds almost any type of pressure vessel and other heavy process equipment

Here is one of two horizontal gas scrubbers recently built for an operating pressure of 1800 psi at 300°F.

Newport News made both vessels from fire box steel, 2⅞ inches in thickness. We formed and automatically welded this steel into sections having a diameter of only 4 feet.

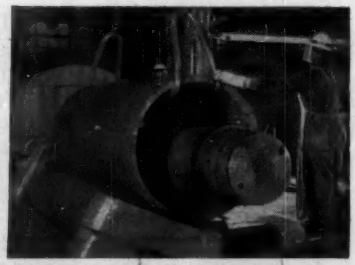
Rolling thick steel to this small diameter...no easy accomplishment, as you probably know . . . demonstrates the sort of jobs Newport News takes in stride.

Almost any type of heavy processing equipment is readily constructed by Newport News in a 225 acre plant comprising huge, fully equipped fabricating and machine shops, foundries, forge and die shops, heat treating and allied equipment as well as complete test facilities.

Newport News shop erection of fabricated units helps to speed assembly at your plant site.

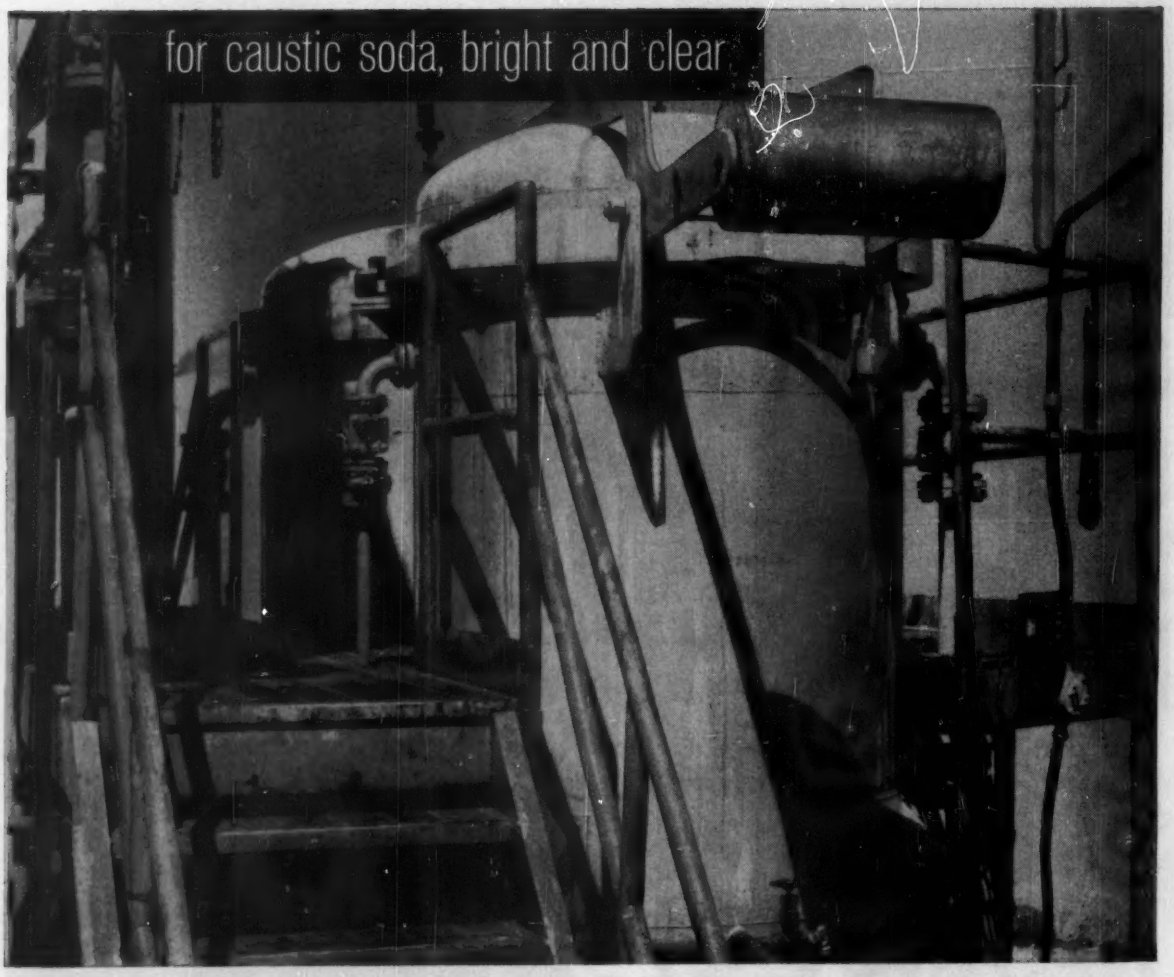
Get a bid from Newport News on your present or future projects. Get the benefit of specialized production techniques. Look over the many ways in which Newport News can help you . . . write for "Facilities and Products", a very interesting booklet. It's yours for the asking.

ENGINEERS Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.



ROLLING 2⅞" STEEL for gas scrubbers. The steel, in a hot condition, was formed on the heavy bending equipment shown here. It will cold roll mild steel up to 3 inches thick, and will hot roll any grade of steel up to a thickness of 5 inches.

Newport News Shipbuilding and Dry Dock Company
Newport News, Virginia



Stauffer picks Process Filters

To remove the final trace of turbidity from caustic soda, Stauffer Chemical Company installed two Process Vertical Pressure Leaf Filters at its Henderson, Nevada plant. Net result: "A bright, clear product for customers."

Says Stauffer: "PF Filters were selected after a survey of various pressure leaf filters and a series of pilot tests on this one. The equipment has been completely satisfactory as has been Process Filters' service."

Because of their efficient, time-saving performance, PF Filters are highly regarded throughout the chemical and petrochemical industries. Available in standard and specially engineered units with a wide range of accessories, they can be adapted to extremely diverse process conditions.

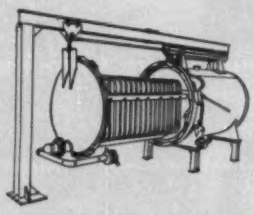
PF Filters are designed and built by forward-looking specialists who have come up with numerous filtration innovations: Rapid-Opening Covers, Quick-Change Cloth and Paper Bags, Automatic Leaf Shut-Off and Batch Recovery Leaves that provide twice the normal filtering area ... to name a few.

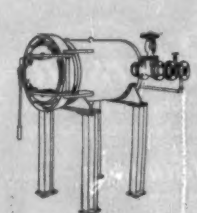
Why not get more facts on how Process Filters can boost your output at substantial savings? For specific information on one or more of the types shown below, request Bulletins listed.

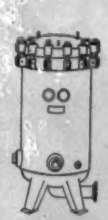
Process Filters, Inc. *(A subsidiary of Bowser, Inc.)*
1302 East Creighton Ave., Fort Wayne, Ind.


VERTICAL LEAF FILTERS
Bulletin V


VERTICAL BATCH FILTERS
Bulletin VBO


HORIZONTAL LEAF FILTERS
Bulletin H


HORIZONTAL BATCH FILTERS
Bulletin HB


CARTRIDGE FILTERS
Bulletin C

pf

INTERNATIONAL'S

99+% MgO

Heard the news about *International* magnesium oxide? Highest purity ever achieved in carload quantities . . . purity you'd expect to find only in laboratory-controlled samples. And it's in the low price range!

Not to mention wide application. Among its uses: As a stabilizing and vulcanizing agent for rubber . . . in high-grade ceramic and glass formulations . . . for acid neutralization, electrical insulation, uranium ore treatment. It has demonstrated its worth in both high-purity magnesium chemicals and in low-sulfate, high-magnesium catalysts. What's more, *International* MgO has proved preferable to magnesia produced by conventional methods. And there's still more to come through *International* research.

A test sample of low-iron, low-lime *International* MgO in any of its three forms — powdered, pelletized or granular — is yours for the request. Please do — today.

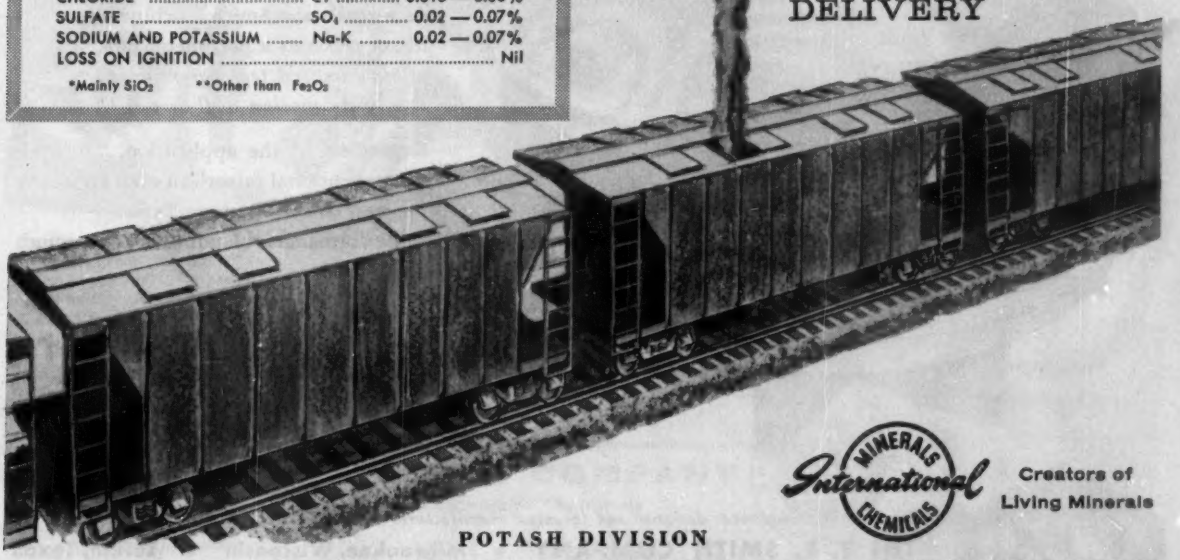
CHEMICAL SPECIFICATIONS

Chemical		Purity Range
MAGNESIUM OXIDE	MgO	99.40 — 99.70%
IRON	Fe_2O_3	0.03 — 0.06%
LIME	CaO	0.07 — 0.08%
ACID INSOL.*		0.02 — 0.10%
OXIDES**	R_2O_3	0.04 — 0.09%
BORON	B_2O_3	0.0025 — 0.015%
CHLORIDE	Cl	0.015 — 0.06%
SULFATE	SO_4	0.02 — 0.07%
SODIUM AND POTASSIUM	Na-K	0.02 — 0.07%
LOSS ON IGNITION		Nil

*Mainly SiO_2 **Other than Fe_2O_3

LABORATORY PURITY...

CARLOAD DELIVERY



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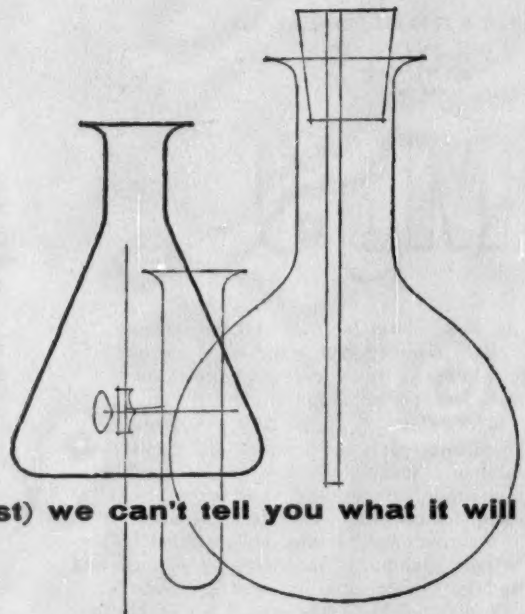
PI-2-108

what
will the **STTM**
do for the
chemical industry?



so new (and so fast) we can't tell you what it will do!

Perhaps you've heard about it—
the phenomenal new
Smith Turbine-Type Mixer
that's changing performance standards
in dozens of industries.

"LIVE MIX" — *an entirely new principle*
Mixing is done in a doughnut-shaped drum. There is no "dead center" area. Blades set up a braiding action which breaks down centrifugal forces. As a result the Smith Turbine-Type Mixer mixes at a peripheral rate of *six hundred feet per minute!* It is truly *motion well directed.*

Regardless of the application, no conventional mixer can even approach the new Smith Turbine-Type in performance: blending is as thorough as it is fast.

Outline your problems...
we'll give you the answers (based on the almost unbelievable test records of this new mixer in various fields). No obligation.

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Since 1900, the pioneer designer and foremost manufacturer of the world's finest mixers.
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A8-4044-1P

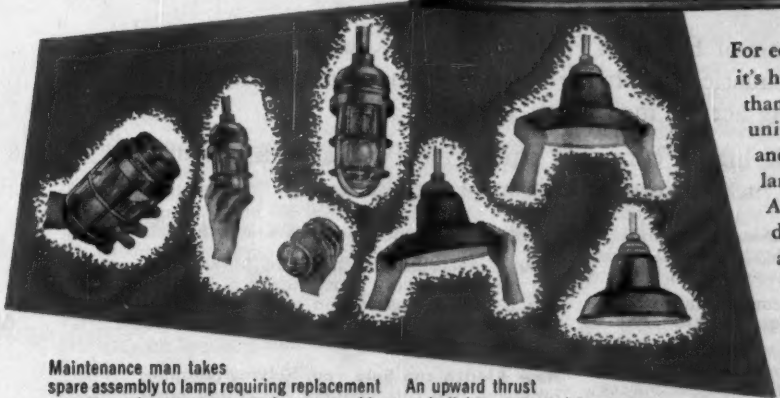
APPLETON V-51 SERIES CONVERTIBLE VAPORTIGHT FIXTURES

Require only seconds

to relamp or convert!

One trip up the ladder, a few quick twists of the wrist, and relamping or wattage conversion is done! V-51 reflectors with integral neoprene ring adapt perfectly to the grooved unilet... permit instantaneous substitution of reflectors.

U. S. Pat. 2,749,433 2,749,435 2,715,214
Canada Pat. 531,655 511,696



Maintenance man takes spare assembly to lamp requiring replacement or wattage change... removes lamp assembly ...screws fresh unit in place and the job is done! Higher wattages of 150/200 are interchangeable with 100 watt unit and can be used in same unilet body. (Die-cast aluminum guard turns counter clockwise to act as a tool for easy removal in relamping).

An upward thrust and slight quarter twist engages neoprene ring with the groove in the unilet and snaps the reflector in position. Entire operation of removing lamp, inserting new unilet, and positioning of reflector requires no special tools... no set screws... no small parts to juggle. Absolute simplicity!

For economical service and maintenance, it's hard to find anything more practical than Appleton's V-51 Series exclusive unit assembly (adapter, receptacle, globe, and guard). Shock absorbing socket cuts lamp replacement costs. Try the Appleton V-51 Series standard or shallow dome, deep bowl, or angle type reflectors and 100 W and 150/200 W vaportight unit assemblies in your plant today. Available in a variety of hub sizes in pendent, ceiling, or bracket type fixtures for every kind of installation.

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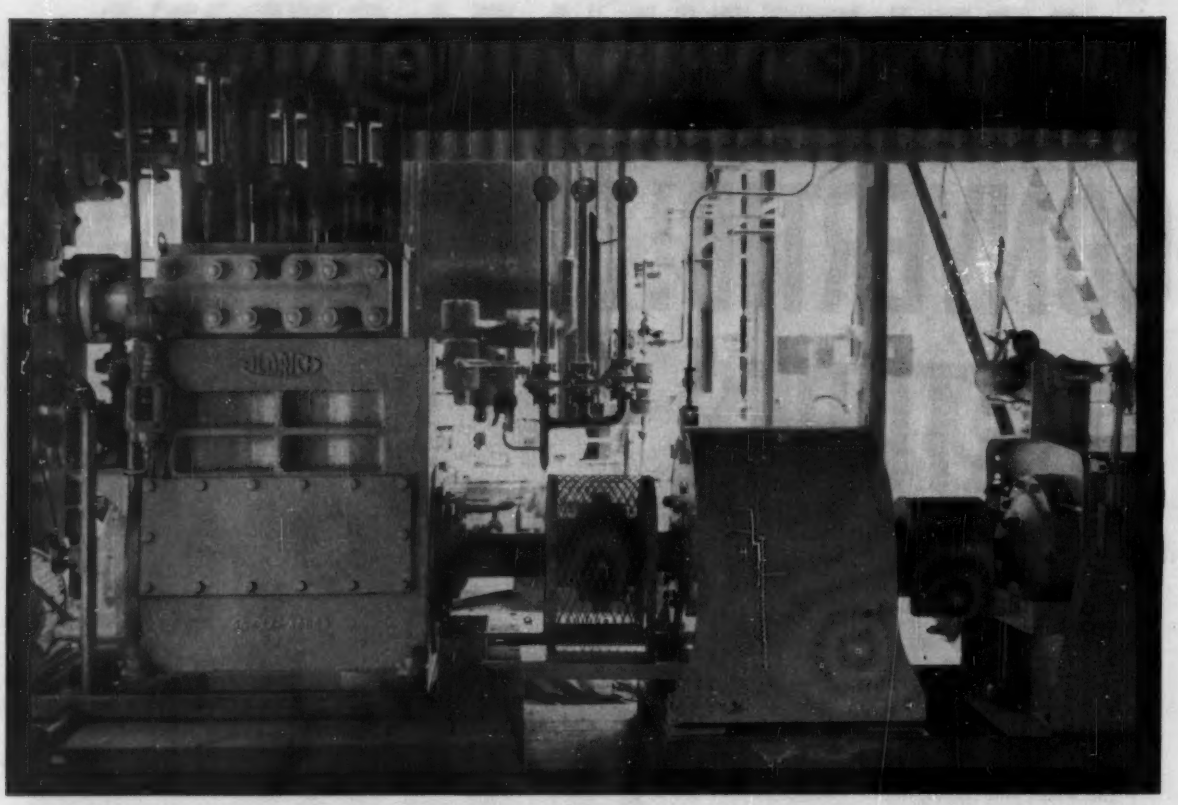


THE PRESSURES ARE HIGH...THE LIQUIDS CORROSIVE...THE PUMPS ARE ALDRICH...

At the Houston plant of Rohm & Haas Co., this Aldrich pump alternately introduces caustic and brine into one phase of the acrylate process for producing acrylic monomers.

The problem: Handle highly corrosive liquids at 3000 psi in a continuous process and *not* have severe maintenance problems.

What Rohm & Haas did about it. Company engineers specified Aldrich 1⅝" x 5" stroke Triplex Pumps for three reasons.

1. Compact, heavy-duty construction makes Aldrich pumps ideal for high pressure service.

2. Aldrich pumps are designed for easy maintenance. Fluid-end sectionalization permits quick removal of valves for inspection or replacement. No special tools are required.

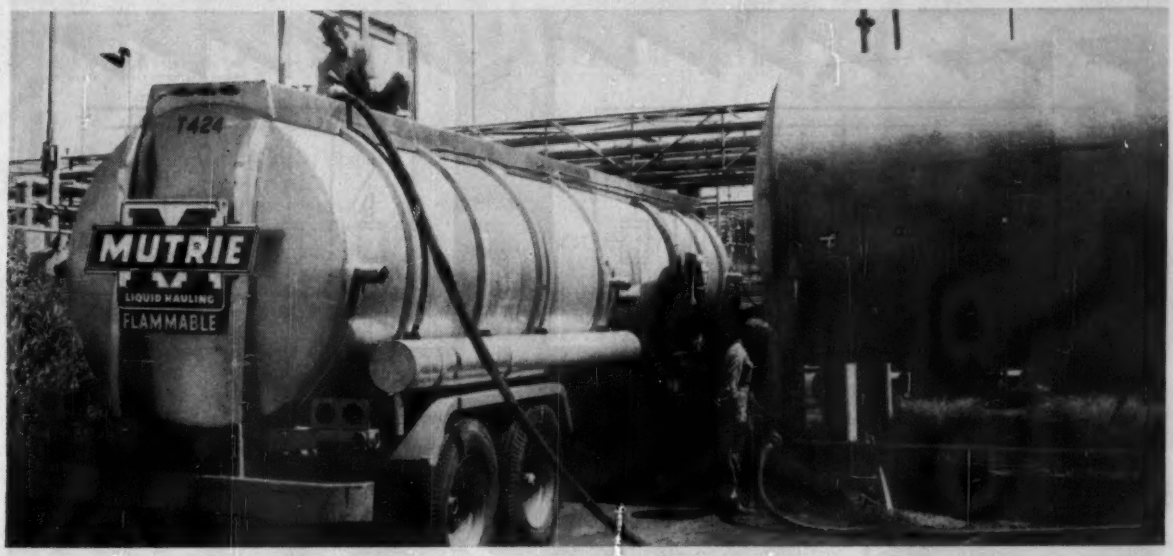
3. Aldrich engineers can draw upon a vast store of experience when it comes to selecting the right materials for any pumping job. In this case, the entire fluid end . . . working barrel, suction and discharge manifolds . . . are forged Monel. Valve seats are Haynes Stellite. Valves and plungers are K Monel.

Results: According to the Plant Manager of the Houston plant, "maintenance requirements have decreased and pumping production improved. These Aldrich pumps lend themselves to easy maintenance."

How Aldrich can help you. Solving pumping problems like this requires specialized engineering skills and experience. We have those skills, and our experience comes from years of working with the chemical industry. We welcome the opportunity to discuss your specific problems . . . no matter what the liquid or how high the pressures. Aldrich Pump Company, 3 Gordon Street, Allentown, Pa.

the toughest pumping problems go to ALDRICH

Deliver your liquid or molten products contaminant-free at less cost in Stainless Steel tankers



One of a large fleet of stainless tankers operated by P. B. Mutrie Transport, Inc., Waltham, Mass., for versatile hauling of chemicals and other liquid products. This is a 6695 gal., Type 304L, 3-compartment tanker with pressure unloading equipment.

The rapidly expanding use of both company-owned and carrier stainless steel tank trailers to haul a wide range of chemicals is good evidence that they provide better, lower-cost service.

Resistant to a greater number of compounds than other tank materials and extremely easy to clean, stainless insures contaminant-free shipment of raw materials, intermediates and finished products. Its high strength and durability at elevated temperatures means you can extend the efficiency of bulk hauling to molten salts, such as phthalic anhydride and viscous materials. The high strength of stainless also permits the design of tankers for pressure unloading without weight penalty.

In tank trailers, stainless steel provides the added advantages of maximum versatility, long service life with little maintenance and lowest overall cost. When you hire a carrier, multi-purpose stainless tankers enable him to provide you with more reliable, prompt and versatile service.

Make full use of the advantages of tank trailers made of Armco Stainless Steel in shipping *your* products. For more information on stainless tank trailers and the names of tank manufacturers just fill out and mail the coupon.

GO STAINLESS FOR A VERSATILE FLEET

New steels are born at Armco

ARMCO STEEL CORPORATION, 3068 Curtis St., Middletown, Ohio

☐ Send me your booklet, "Make Your Tank Fleet Versatile—Go Stainless"

☐ Send me names of manufacturers of stainless tank trailers

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ALUNDUM* Catalyst Carriers and Supports improve and economize many processes

It will pay you to investigate what many chemical engineers have already discovered — that Norton ALUNDUM catalyst carriers are ideal aids to better, lower cost production in a wide range of processing.

These fused alumina carriers have excellent mechanical, thermal and chemical stability. Crystalline in nature, they are produced in two surface area types: Intermediate (5-70m²/gram) and Low (less than 1m²/gram). Intermediate carriers, subdivided into types A, B and C, have an alumina content of approximately 77%. In the low surface area carriers the alumina content ranges from 77% to 92%.

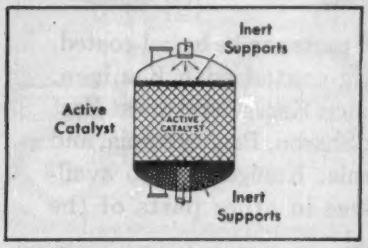
Some of Many Applications

For Intermediate Surface Carriers: catalytic reforming, dehydrogenation, dehydration, sulfuric acid manufacture, nitric acid manufacture and desiccants.

Low Surface Area Carriers: processing phthalic anhydride, maleic anhydride and ethylene oxide; also in protective atmospheres and synthetic gas generation.

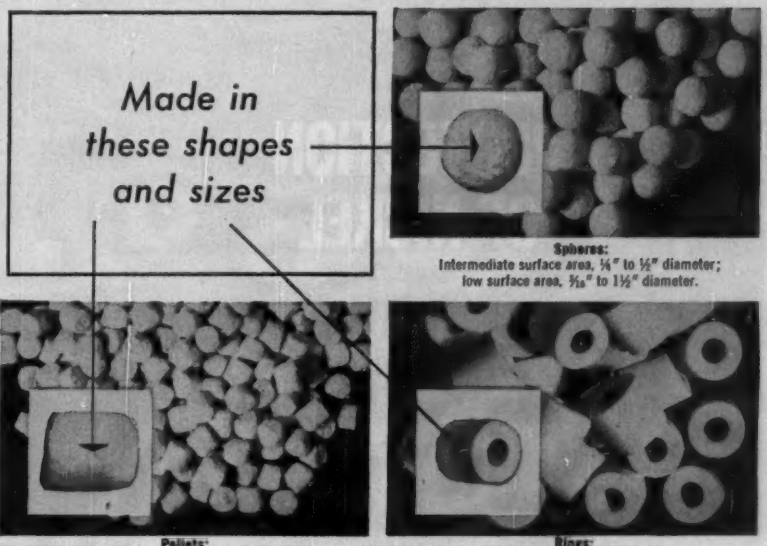
Catalyst Supports in Fixed Bed Convertors

Where it is necessary to suspend active catalysts at a given level, supports produced by Norton are used successfully. Made of dense, rugged, electrically fused materials, these supports have great resistance to breakdown and have no chemically reactive effect on the processing.



Get More Facts

on how Norton catalyst carriers and supports can benefit your processing.



Spheres: Intermediate surface area, ¼" to ½" diameter; low surface area, 3/16" to 1½" diameter.

Pellets: All carriers, ⅛" x ⅛" to ½" x ½"

Rings: All carriers (bore length O.D.), ⅛" x ¼" x ⅜" to 1" x 1½" x 1½"

PHYSICAL PROPERTIES

	Apparent Porosity	Water Absorption	Bulk Density	Packing Density	Crystals Present†	Surface Area††
Intermediate Surface Area Type A ALUMINA	60-65%	50-55%	1.1-1.2 g/cc	45-50 lbs/ft³	Predominantly Gamma Alumina. Some Alpha Alumina. Small amount of Quartz.	60-70m²/gram
Type B ALUMINA	60-65%	50-55%	1.1-1.2 g/cc	45-50 lbs/ft³	Alpha Alumina. Some evidence of Kappa and Delta Alumina. Small amount of Quartz.	20-30m²/gram
Type C ALUMINA	60-65%	50-55%	1.1-1.2 g/cc	45-50 lbs/ft³	Alpha Alumina and Mullite.	5-10m²/gram
Low Surface Area ALUMINA	10-45%	3-30%	1.90-3.15 g/cc	60-110 lbs/ft³	Alpha Alumina and Mullite.	Less than 1m²/gram

†By X-Ray Analysis ††BET Method

On request they can be prepared from other materials, including CRYSTOLON* silicon carbide, MAGNORITE* fused magnesia, zirconium oxide, zircon, silica, etc. Call on your Norton Refractories Engineer or write for Bulletin No. 7 to NORTON COMPANY, Refractories Division, 512 New Bond Street, Worcester 6, Mass.

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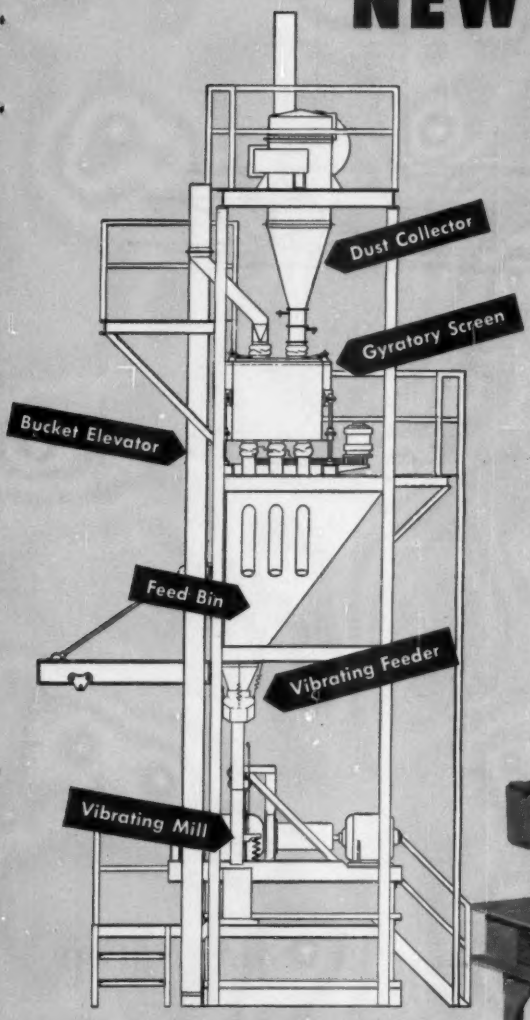
ALLIS-CHALMERS

NEW grinding plant

15 to 30 times more capacity

50% less space required

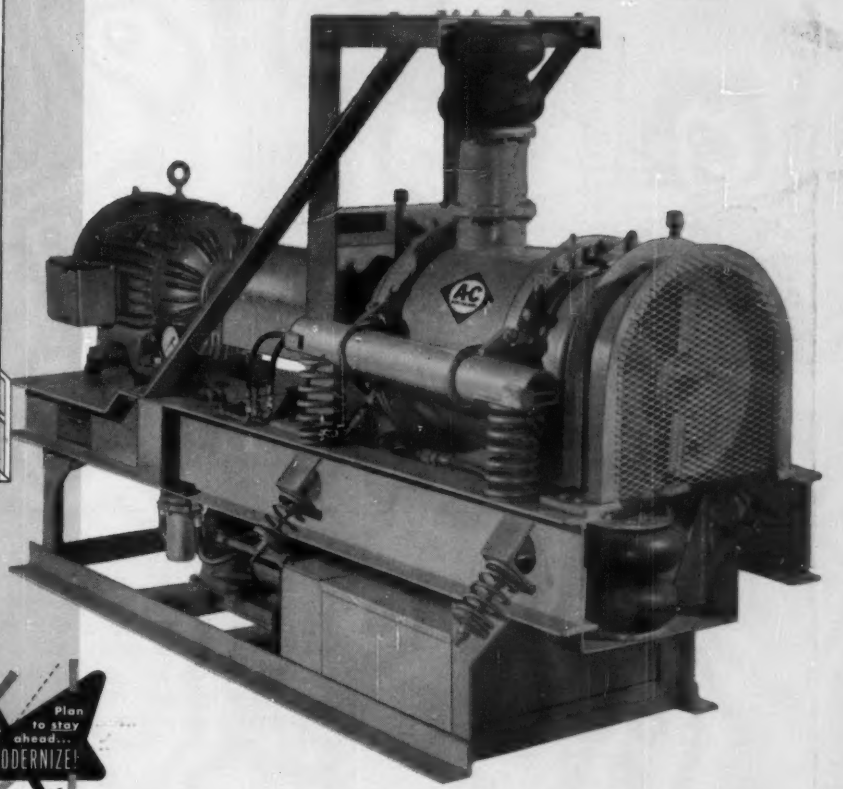
a complete "package" — at a surprisingly low cost



Plant includes structural steel, platforms, ladders and processing equipment, motors, and drives — everything match-marked for convenient erection.

You can now process as much as one ton per hour of dry materials within less than 127 square feet of floor space with this new Allis-Chalmers Grinding Plant. Plant components are designed, applied and "coordineered" to handle materials in a 30 to 300 lb per cu ft range. Vibrating mill out-produces a tumbling mill 15 to 30 times per unit volume. The plant is a complete pre-engineered "package" that affords the low price tag of an off-the-shelf item, and built-in flexibility offers tailored-to-the-job performance.

Operating economy, accessibility, cleanliness and easy maintenance of the entire plant are other advantages.



Your local A-C man will give you all the details. Or, write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.

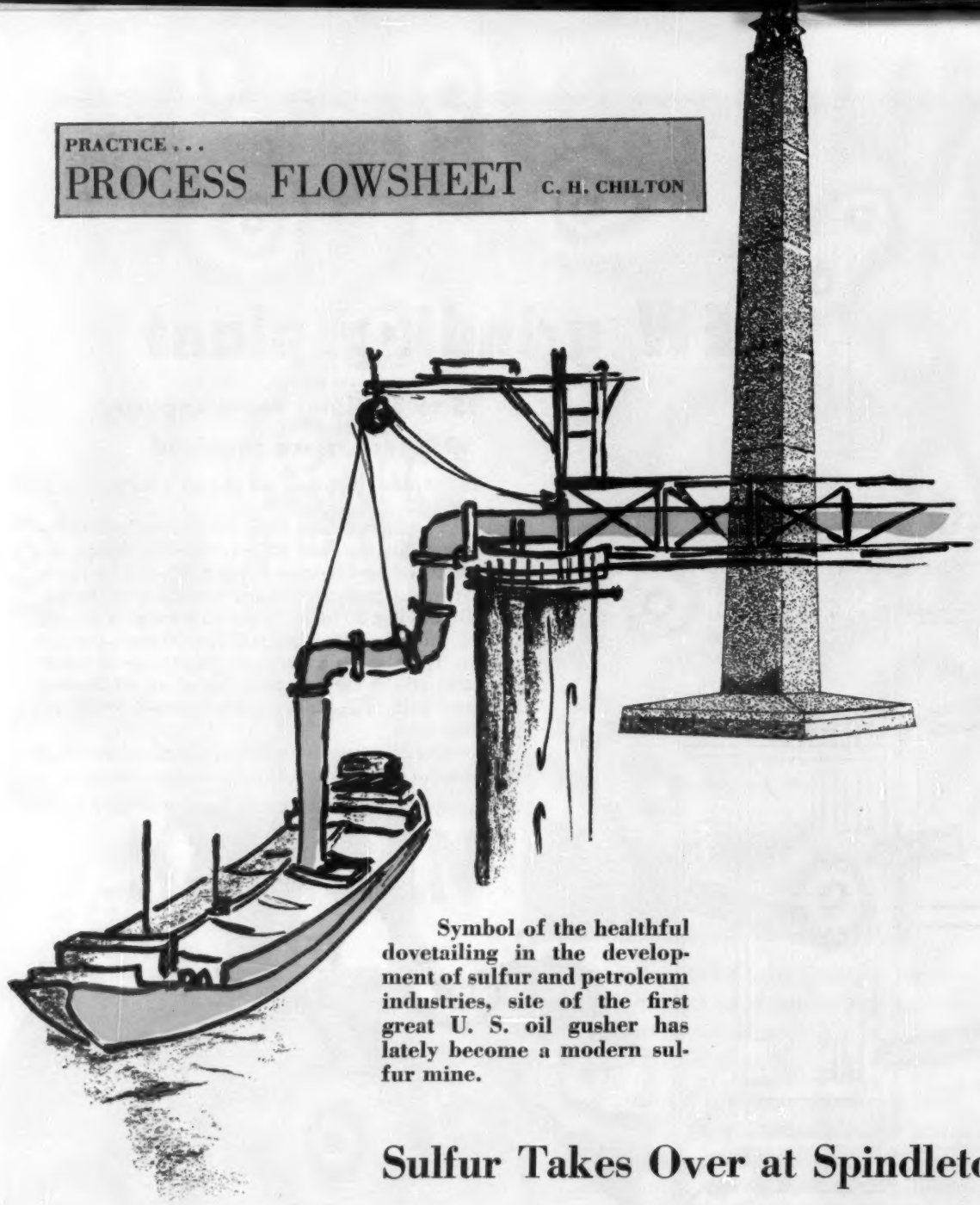
ALLIS-CHALMERS

A-5849

PRACTICE . . .

PROCESS FLOWSHEET

C. H. CHILTON



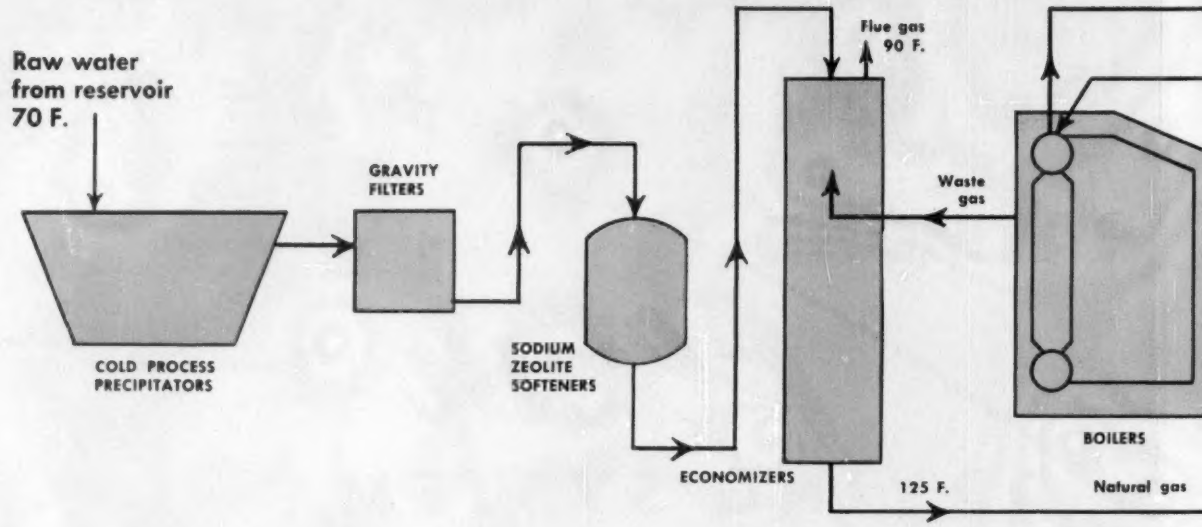
Symbol of the healthful dovetailing in the development of sulfur and petroleum industries, site of the first great U. S. oil gusher has lately become a modern sulfur mine.

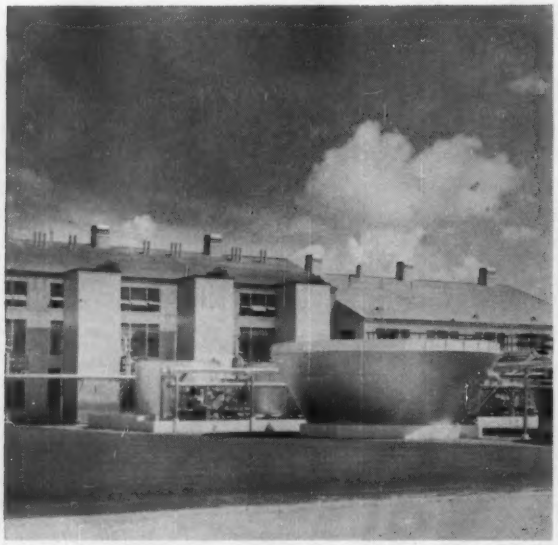
Sulfur Takes Over at Spindletop

Texas Gulf Sulphur Co. built its most modern U. S. plant six years ago on the site of the nation's first great oil gusher, at Spindletop, Tex. The Spindletop gusher not only accelerated development of the modern oil and gas industry, but also—by making cheap fuel abundant — gave modern sulfur mining via the Frasch process its start.

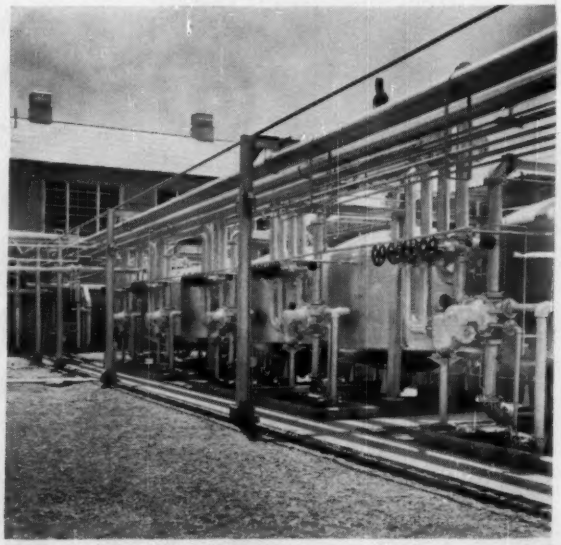
Since these common beginnings 50-odd years ago, the paths of the fast-growing oil and sulfur industries have crossed and re-crossed. ▶ **Common Bonds** — Sulfur often occurs at the flanks of the same kind of salt formation as does oil. Sulfur-bearing impurities are present in most petroleum crudes and have to be removed from petroleum products. For many years,

Unfold Flowsheet





WATER-TREATMENT equipment includes cold-process precipitators, foreground, gravity filters, in back.



ZEOLITE SOFTENERS treat the clarified and filtered water. They are regenerated with sodium chloride brine.

this was done by chemical treatment processes which wasted the sulfur instead of recovering it. Now, about 7.5% of total U. S. sulfur production comes from "sweetening" of petroleum and natural gas.

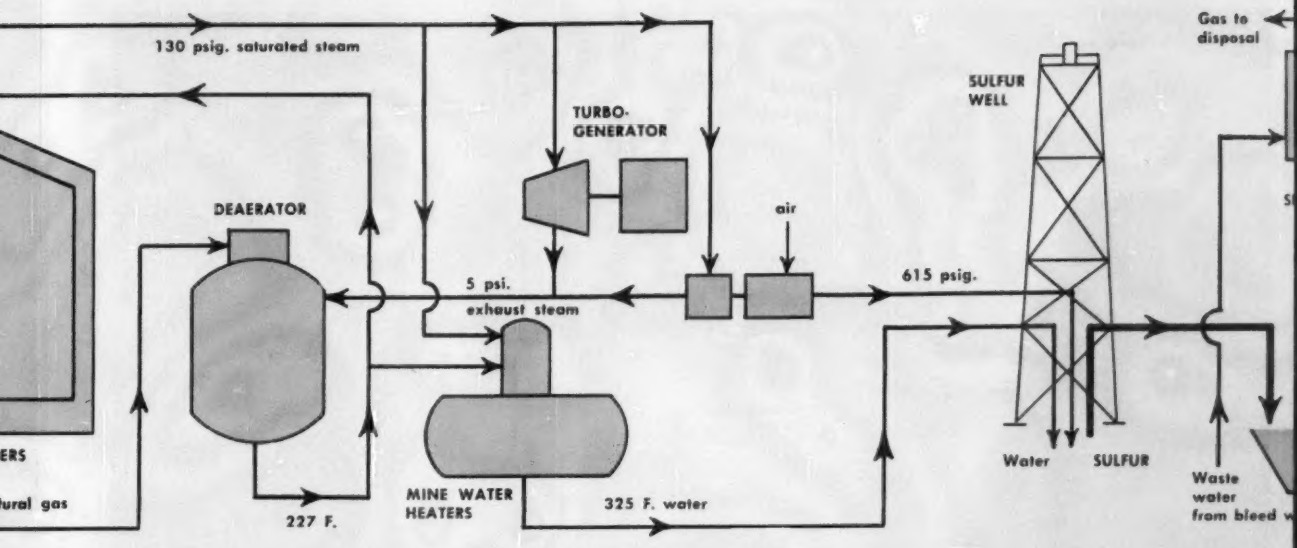
Around 1950 several developments converged to focus a profitable light on sulfur recovery from hydrocarbon sources:

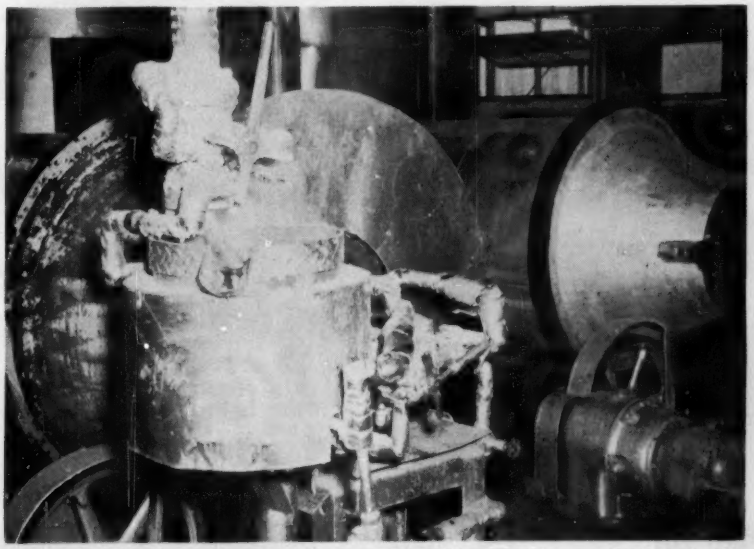
- The Korean War had precipitated a sulfur shortage.
- As low-sulfur (sweet) crudes became scarcer, petroleum refiners were using increasing amounts of sour crudes.
- Hydrorefining processes, which remove sulfur in readily recoverable form from petroleum, got a commercial start. The cheap hydrogen they needed became available within the refinery as a byproduct of the then-new catalytic reforming processes.
- Nationwide emphasis on air pollution control was making an increasing disposal problem of sulfur-bearing gases produced by sulfur-removal processes.

Because deposits of elemental sulfur face ultimate depletion, alternative sources will inevitably gain in importance. Currently at the 500,000-ton/yr. level, production of sulfur from petroleum is expected to double by 1962.

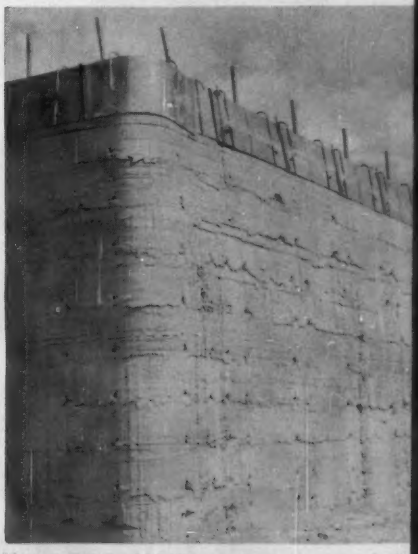
▶ **Off-Shore Too** — But efforts to stave off that day of ultimate depletion of the native element form another point of contact between petroleum and sulfur industries. Several years ago Humble Oil & Refining, prospecting for off-shore oil, found what may be the world's largest sulfur dome about 7½ mi. off the Louisiana coast. Down some 1,800 ft., it has been leased by Freeport Sulphur Co., which is completing a 1-mi.-long steel island from which to conduct drilling operations at the site.

When production begins late in 1960, it will mark the first off-shore sulfur mining operations. And more is expected from underwater drilling. Texas Gulf Sul-





ROTARY BURNERS burn sulfur to make sulfur dioxide, which is absorbed in water to form sulfurous acid for waste water disposal plant.



VATS FOR SOLID product storage buil forms hold molten material until it freez

phur, like Freeport, has interests in off-shore locations. But because of oil and sulfur's similar geological habits, oil companies may be the ones to locate more underwater sulfur domes.

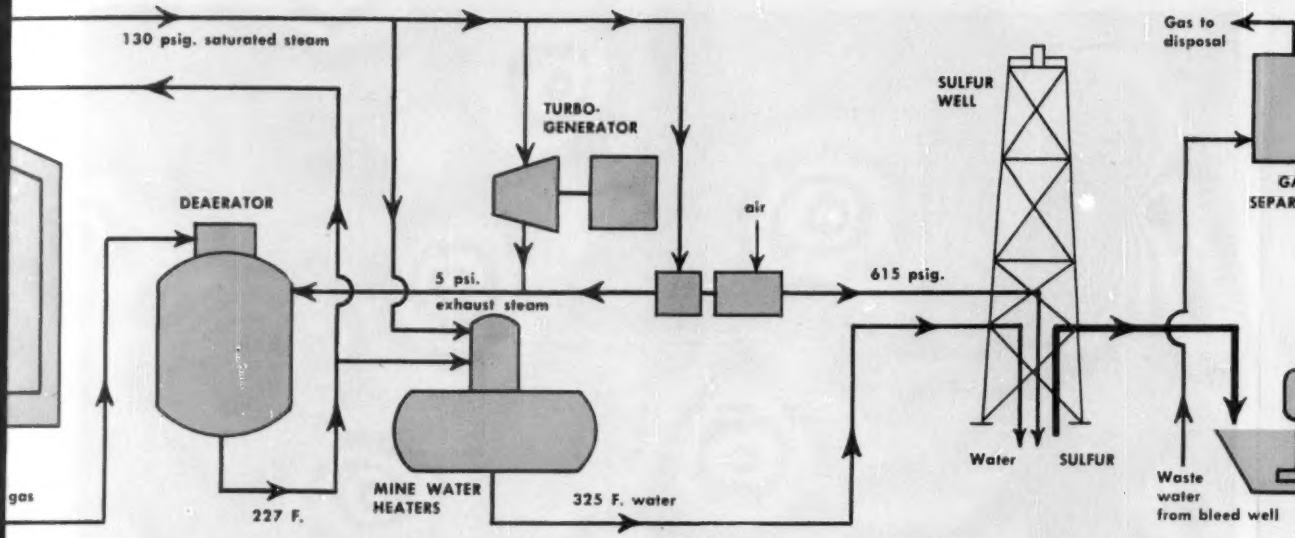
► **At Spindletop**—Land-bound sulfur mining at its most modern is illustrated by Texas Gulf Sulphur's operations at Spindletop. Especially noteworthy are the plant's waste disposal problem and the process developed to handle it.

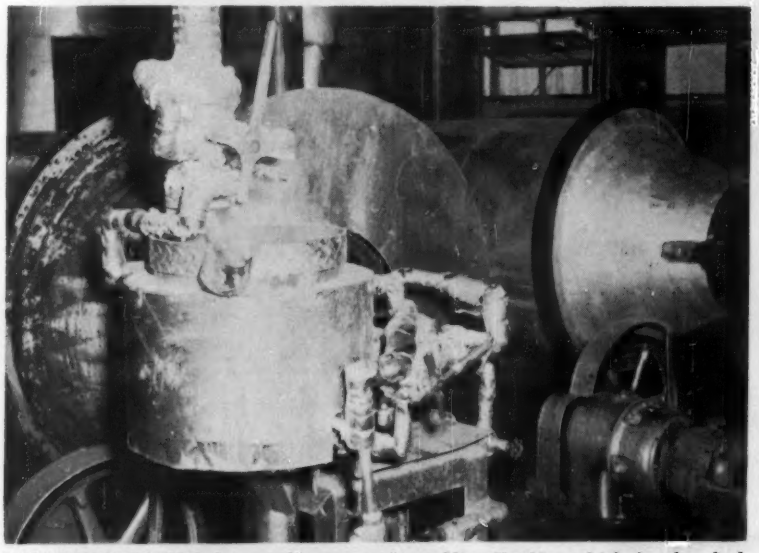
Because the mine is near heavily populated Beaumont and remote from large bodies of water, disposal of its million-odd gal./day of waste water presented difficulties. Luckier Frasch mines in less populous areas can just run it off into the Gulf.

► **Atypical Waste Disposal**—Process at Spindletop uses dilute sulfurous acid to convert soluble sulfides to insoluble elemental sulfur and to insoluble salts (thionates, polythionates, thiosulfates, sulfates, etc.). Sulfur and insoluble salts are easily removed by clarification steps. Soluble compounds remaining present no stream pollution problems and are discharged into the adjacent Neches estuary (*Chem. Eng.*, Sept. 1954, p. 132).

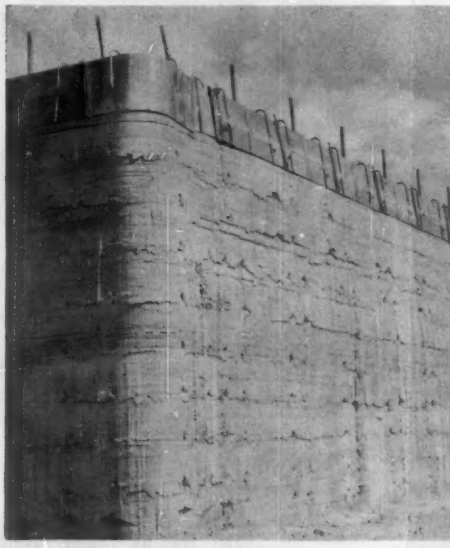
► **Abreast of the Trends** — The amount of sulfur shipped to consumers in molten form is on the increase. Spindletop, typical of newer mining operations, ships both forms: Solid by railroad cars; molten form by tank cars, trucks and barges which are equipped with steam coils for keeping it molten during transit.

For building up the vats of solid sulfur, Spindletop boasts the latest techniques and equipment. TGS uses the sulfur itself to make the vat wall. Aluminum forms, about 16 in. high, are placed around a 1,000-by-150-ft. periphery and filled with molten sulfur. On cooling, this sulfur forms a wall around edge of the vat which confines the sulfur pumped onto the vat.





ROTARY BURNERS burn sulfur to make sulfur dioxide, which is absorbed in water to form sulfurous acid for waste water disposal plant.



VATS FOR SOLID product storage build to forms hold molten material until it freezes to

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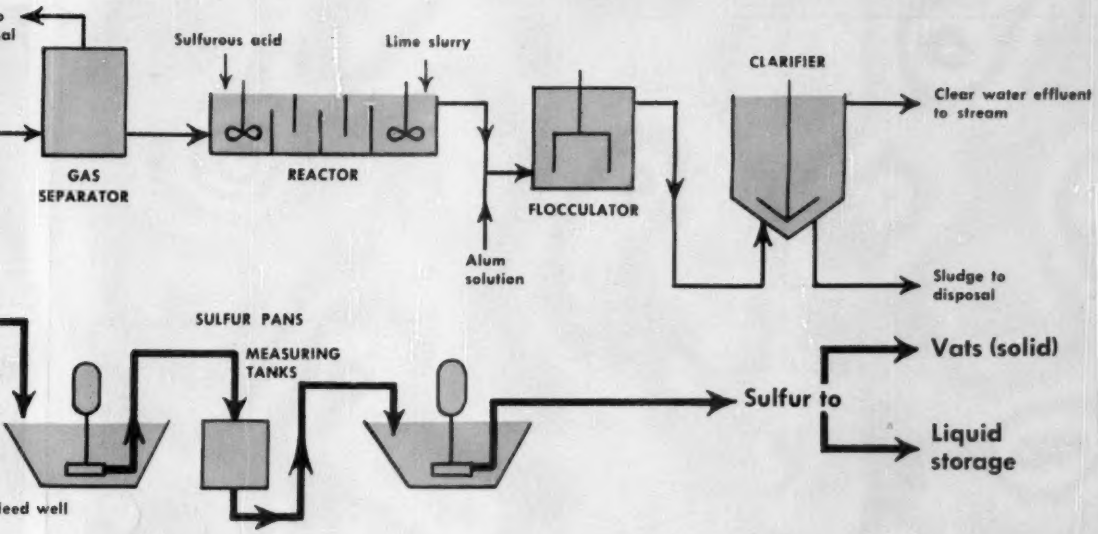
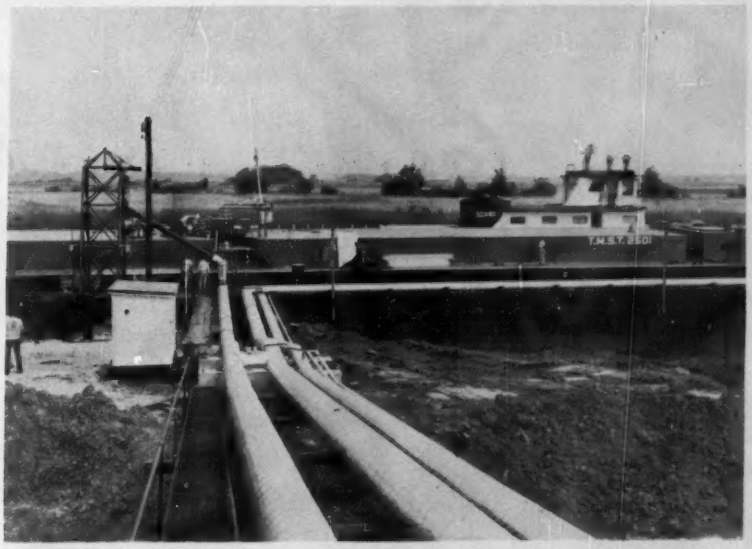


build to 25-50 ft. Raisable aluminum reezes to form its own retaining wall.



SHIPPING MOLTEN sulfur long distances started about 1955. Shown unloading in East St. Louis, Spindletop sulfur comes upriver in heated, insulated barges.

Since sulfur is a poor conductor of heat, it must be spread over a large area to insure its even cooling and solidification. The molten material is distributed through a pipe mounted on frames running the entire length of the vat. As the vat fills, the frames and aluminum forms are raised, a new wall built, and distribution continued.

When the vat is complete (built to a height of 25-50 ft.), the solid sulfur, 99.5% pure, is ready for shipment.

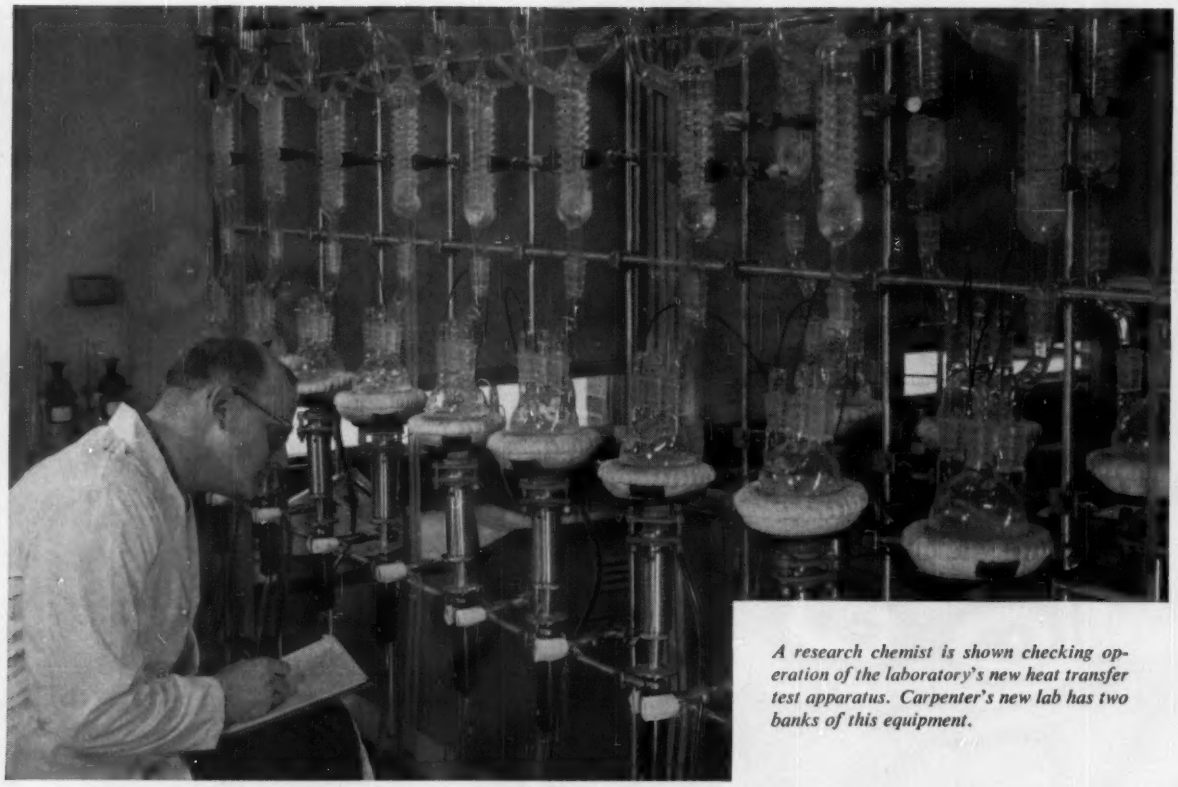
► **Frasch Refresher**—The Frasch method of mining sulfur involves three basic operations: Heating large volumes of treated water in a power plant; pumping the hot water into the deposit through the wells to melt the sulfur; raising the melted sulfur to the surface.

The well consists of four concentric pipes. Hot water, forced down one annulus, melts and frees the pure sulfur. Piping arrangement is such that water-free sulfur rises through another annulus with the aid of compressed air introduced through the center pipe.

The amount of water required varies widely from mine to mine—from 4 to 50 tons/ton of sulfur produced. It depends on differences in richness, porosity and character of the formation of the sulfur dome, and also on the skill of the operator. Water consumption for a particular mine is one factor the industry never divulges.

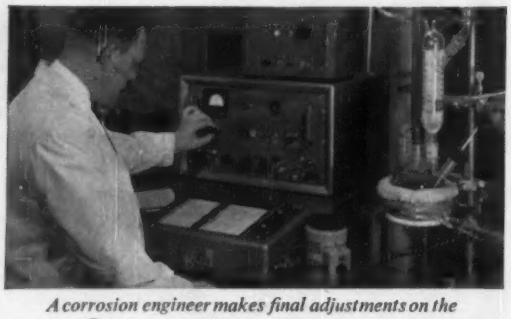
► **Water Treatment** — The Neches River is Spindletop's source of water. Raw water must undergo: Chlorination, then clarification in precipitators through the use of alum and activiated silica; gravity sand filtration after pH adjustment with sodium carbonate; softening to zero hardness in zeolite softeners; removal of dissolved gases, such as carbon dioxide, by means of deaerating heaters.

Part of the softened water is used as boiler feed water. Steam from the boiler heats the rest of the water to 320 F. before it is pumped to the mining area.

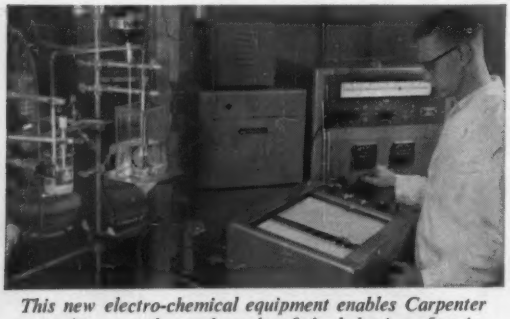


A research chemist is shown checking operation of the laboratory's new heat transfer test apparatus. Carpenter's new lab has two banks of this equipment.

Carpenter's new corrosion laboratory can predict stainless tubing performance on your job



A corrosion engineer makes final adjustments on the new Corrosometer.



This new electro-chemical equipment enables Carpenter to make more thorough study of the behavior of stainless steels and thus gather more background for the development of new and improved alloys.

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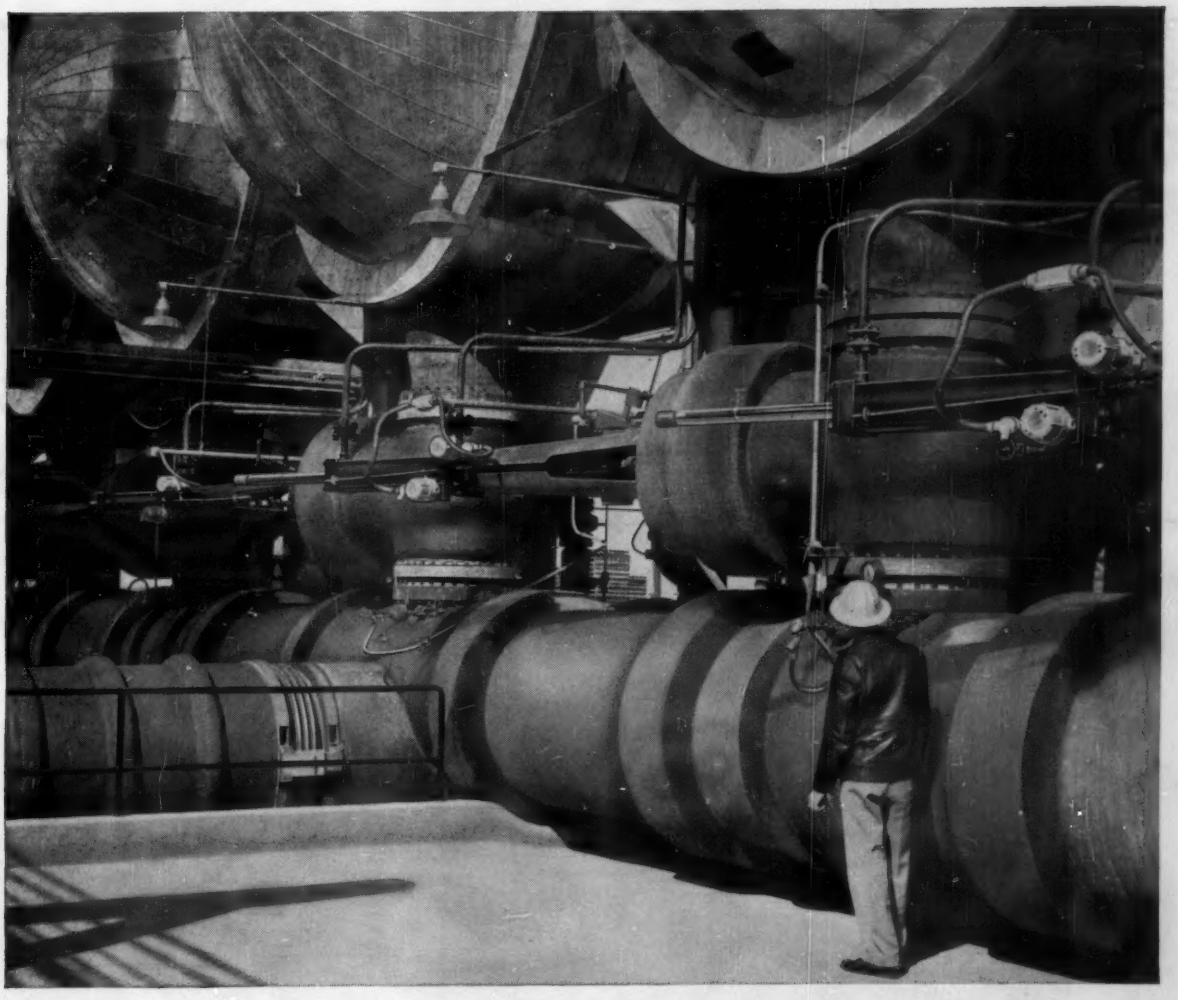
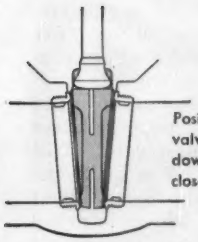


Big valves on high-temperature ultra-frequent cycling service prove positive seating of Crane flexible disc



Positive seating principle of Crane flexible disc gate valves. Holds tight at both seat faces—*upstream* and downstream. Also overcomes sticking of disc when closed hot and opened cold.

16 months ago Texas Butadiene & Chemical Co., Channelview, Texas, installed 42 Crane 30-inch steel flexible disc gates as switch valves on the butadiene processing lines in its new plant.

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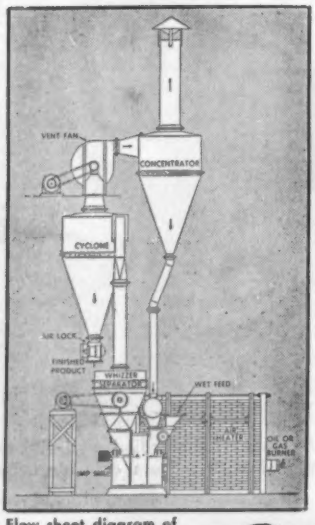

Flow sheet diagram of Raymond Flash Drying System

Raymond Imp Mill with Flash Drying accessories including package-type furnace

By this modern method of processing powdered materials, you can remove any percentage of moisture from the product while grinding . . . and obtain a uniform finished material of specified dryness and fineness.

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- For calcining some materials such as gypsum, copper sulphate, di-calcium phosphate and other hydrate compounds.

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Chemical Engineering

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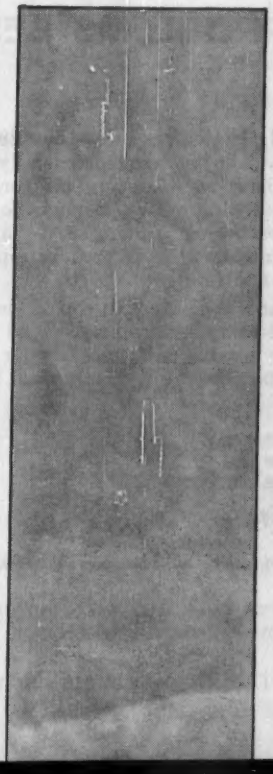

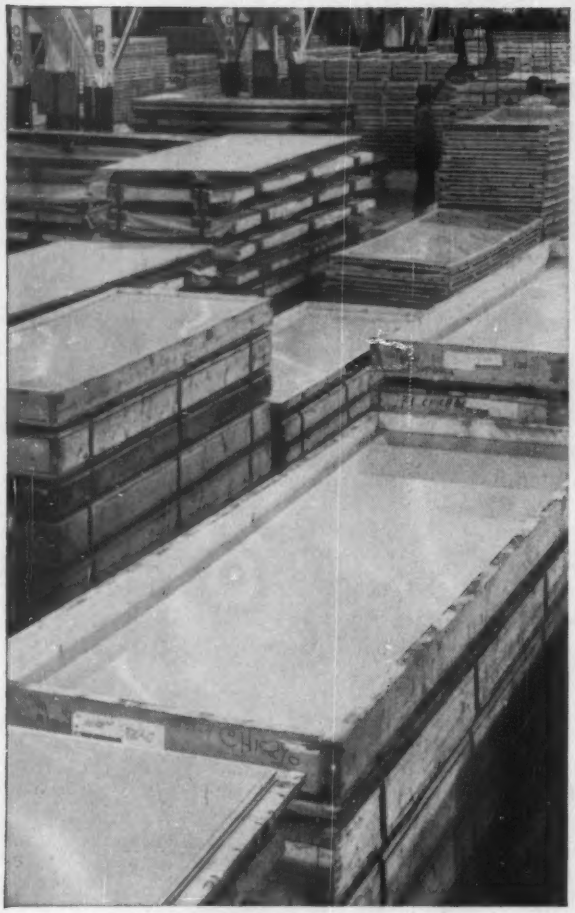

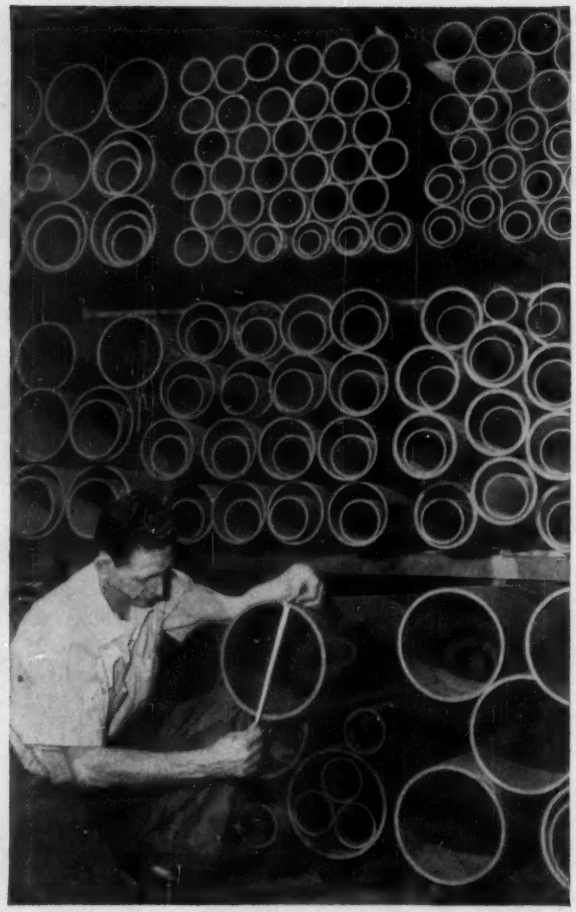

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Chemical Engineering
NOVEMBER 17, 1958

Air-Cooled Heat Exchangers

Why cool with air instead of water?
How fast can air-cooled units transfer heat?
What types of exchangers can you buy?
How do you make a design-cost estimate?

ENNIS C. SMITH, Hudson Engineering Corp., Houston, Tex.

DIRECT cooling of fluids by passing ambient air over extended (finned) tube surfaces is a comparatively recent innovation. Its application has been cautiously adopted because of the usual reluctance to change from conventional methods, and because of the lack of available publications which provide information to potential users for rating and estimating air-cooled exchangers.

We hope this article will serve as a tool to plant and process designers, heat transfer study groups and specification engineers for determining approximate surface, operating power, plan area, weight and price information for air-cooled heat exchanger applications.

Why Air Makes a Good Coolant

Some typical general advantages of direct cooling with air as compared to cooling with water in shell-and-tube exchangers are:

- Eliminates problem of temperature rise in, and chemical pollution of, water resources.
- Enables location of plant to be independent of water supply.
- Enables cooler location directly adjacent to process equipment without necessity of coolant piping.
- Minimizes heat exchanger maintenance costs. Descaling of water-contacted surface is eliminated, as is additional surface required because of water-side fouling. Well-designed mechanical drives—operating in an inherently noncorrosive atmosphere—are almost completely trouble-free.
- Since the available water temperature, either from a cooling tower or natural source, is usually above the average air temperature during colder

months, the available approach of outlet-fluid to cold-coolant temperature on an annual basis favors air cooling.

• In the event of power failure water circulation through shell-and-tube coolers will immediately cease. Depending upon temperature level and design heat transfer rate, the capacity of an air-cooled system with fans off may be up to 40% of design capacity because of natural induced draft and radiation..

• Process fluid temperature is easy to control. Although control of water flow and temperature rise for the purpose of regulating fluid temperature can be limited by scale deposition at high water temperatures, there is no such limit for air.

• Eliminates water treating costs.

• Air cooling is more advantageous for cooling high-pressure streams. The fluid is always inside the tubes. Tube sheet thickness is considerably reduced because of high ligament efficiency (greater tube spacing), and because tube sheet may usually be of steel rather than of a nonferrous alloy. Air-cooled exchangers are now operating at 7,500 psig. cooling hydrogen.

• Ground area requirements can be minimized by installing air-cooled exchangers at elevations above other operating equipment, or above roadways. Frequently, shell-and-tube exchangers or pumps are mounted below air-cooled equipment and monorails with trolley hoists are carried by the air-cooled exchanger structure for servicing the equipment mounted below.

Typical Transfer Coefficients For Air-Cooled Exchangers

	U Btu./(hr., sq. ft., deg. F.)
Condensing service	
Amine reactivator	90–100
Ammonia	100–120
Freon 12	60–80
Heavy naphtha	60–70
Light gasoline	80
Light hydrocarbons	80–95
Light naphtha	70–80
Reactor effluent—Platformers, Rexformers, Hydroformers	60–80
Steam (0–20 psig.)	130–140
Still overhead—light naphthas, steam and non-condens. gas	60–70
Gas cooling service	
Air or flue gas @ 50 psig. ($\Delta P = 1$ psi.)	10
Air or flue gas @ 100 psig. ($\Delta P = 2$ psi.)	20
Air of flue gas @ 100 psig. ($\Delta P = 5$ psi.)	30
Ammonia reactor stream	80–90
Hydrocarbon gases @ 15–50 psig. ($\Delta P = 1$ psi.)	30–40
Hydrocarbon gases @ 50–250 psig. ($\Delta P = 3$ psi.)	50–60
Hydrocarbon gases @ 250–1,500 psig. ($\Delta P = 5$ psi.)	70–90
Liquid cooling service	
Engine jacket water	120–130
Fuel oil	20–30
Hydroformer and Platformer liquids	70
Light gas oil	60–70
Light hydrocarbons	75–95
Light naphtha	70
Process water	105–120
Residuum	10–20
Tar	5–10

Coefficients are based on outside bare tube surface for 1-in. O. D. tubes with 8 extruded Al fins/in., ½ in. high, 16.9 surface ratio.

Over-All Heat Transfer

The basic heat transfer relationships employed in shell-and-tube exchanger design apply to air-cooled heat exchangers. The over-all heat transfer rate U is expressed:

$$\frac{1}{U} = \frac{1}{h_a} + R_m + R_{if} + \frac{1}{h_i}$$

h_a is the air-side transfer coefficient—determined experimentally for a given: tube outside diameter; type, material, spacing and height of fin; and tube spacing in the bundle. This value is referred to the tube outside diameter and includes resistance of the fin metal, the effect of fin efficiency, and resistance of the bond between fin and tube.

R_m is the resistance of the metal of the tube wall as found in the literature for the required material, wall thickness and operating temperature.

R_{if} is the fouling resistance of the fluid inside the tubes—determined from applicable standards or, sometimes, specified by the buyer as a result of his knowledge of and experience with the fluid being cooled.

h_i is the film transfer coefficient for the hot fluid inside cylindrical horizontal tubes—readily obtainable from the literature, and specifically determined by the heat exchanger designer. This value is a function of mass flow rate and the physical and thermal characteristics of the fluid in the tubes.

The table on this page shows over-all heat transfer rates (U) referred to bare tube outside surface for 1-in. O.D. tubes (0.262 sq. ft./linear ft.). Fins are ½ in. high, spaced 8 per inch, with a surface ratio of 16.9. The values are typical design coefficients based upon inside coefficients permissible with the usual allowable tube-side pressure drops, usual fouling resistances, and optimum air velocities and air-side coefficients for the individual services listed.

Applications with comparatively high tube-side coefficients have relatively high design air velocities, whereas low inside coefficients result in selection of low air velocities. The lower the tube-side coefficient, the more critical becomes pressure drop in design considerations; the higher the tube-side coefficient, the more surface requirements are affected by design fouling resistances.

Finned Tubes and Exchangers

In evaluating commercially available finned tubing, the buyer should consider not only its initial ability to transmit heat, but also its ability to perform over long periods of operation with repeated thermal shock. Of importance in this respect are:

• The average fin thickness influences heat flux through the fin and relative structural rigidity.

• Fin cross-sectional shape determines fin efficiency and structural strength. Parabolic shape is ideal; triangular shape is only slightly less effective.

• Method of fin attachment fixes the amount of fin material surface in bonded metal-to-metal contact with the outside surface of the tube. This determines heat flux between fin material and tube.

• The smoothness of contour and surface controls resistance to air flow.

A great deal of research and experience has determined the various fin dimensions and tube pitch now used in industrial applications. For a 1-in. O.D. tube, fin heights vary from 0.5 to 0.625 in., fin spacing from 7 to 11 per linear inch, and tube pitch from 2.0 to 2.5 in.

Ratio of extended surface to bare tube outside surface varies from 10 to 20. Net free area for air flow through each tube row is about 50% of the face area of the bundle.

Design air-side coefficients (h_o) vary from 100 to 200 Btu./(hr., sq. ft., deg. F.) referred to bare tube outside surface for a variation of air face-velocity from 300 to 750 ft./min. Ideally fin height and spacing and tube pitch would vary with the service. Practically, manufacturers find it more economical to limit fin configurations to a few standard selections.

No allowance has been included in the above equation for fouling resistance on the external (finned) surface. With only minimum maintenance there is no appreciable detrimental effect of external fouling on heat transfer rates. The exchanger should be cleaned by means of an air, water or steam jet at least once yearly. Even when considerably fouled with dirt, lint, salt encrustations or other foreign material, the unit capacity is reduced not so much by fouling as by reductions in mean temperature difference and air-side coefficient due to restricted air flow.

Industrial air-cooled heat exchangers usually have rectangular bundles containing several rows of tubes, horizontally aligned and vertically offset. Air flows vertically upward across the tube bank. Air flow is either induced by fans above the bundle or forced by fans below the bundle. Heat transfer is substantially countercurrent, since the hot fluid enters at the top of the bundle and flows downward through successive passes. Within practical limits, the longer the tubes and the greater the number of tube rows, the less expensive the surface becomes on a unit sq. ft. basis.

Bundles of standard design are available in widths of 8 ft., lengths to 30 ft. and depths to 8 rows. Usually the maximum dimensions are dictated by shipping limitations. Standard lengths are 8, 10, 12, 20, 24 and 30 ft. Bundles may be stacked, resulting in a total depth of up to 30 rows of tubes to suit the particular service. Individual bundle depth may be limited, or horizontally split headers required, by services with excessively high fluid temperature differences per pass, in order to accommodate tube expansion.

One or more bundles of the same or different service may be combined in one unit. Bundles of differing depth, where combined in one unit, are designed for the same air static pressure and, consequently, varying air velocities. Units of relatively equal width and length usually have one fan, whereas longer units may have two or more fans.

Preliminary Estimating Method

The air-cooled heat exchanger designer has considerable latitude in his design alternatives by varying the mass flow rate of the hot fluid and the velocity and temperature rise of the air. Less flexibility is usually available in design of shell-and-tube exchangers, where water velocity is limited to prevent erosion and water temperature rise is limited to reduce scale formation.

One of the first considerations of the designer is to examine the service conditions to determine the optimum tube bundle depth since this materially affects cost and exchanger installation plan area. The most important variables in this regard are the cooling level and the over-all heat transfer rate. In effect these functions determine the relative quantity of air for a given duty (heat load).

If the air quantity per heat unit is comparatively low, the surface may be stacked and the air pumped through with reasonable power consumption per unit of surface. Conversely, if the air requirement is relatively high per heat unit, the surface must be provided in less depth and spread over a greater plan area. In the first case the power is consumed in pumping a small quantity of air against a high static pressure, whereas in the latter case a large air quantity is pumped against a lower static pressure.

In Fig. 1 the relationship between optimum number of tube rows and the function $(T_2 - t_1)/U$ is given. Selections in actual practice may not fall exactly within the shaded area of the curve because the service may have to fit standard units or because other relative values may be given to fan power and first costs than those used here.

Values on this curve do not necessarily represent the lowest surface selection. The shape of the curve is dependent upon the variation of horsepower with air velocity, the change in surface cost with respect to bundle depth, the density of the available air and the relationship between operating cost and first cost. Stringent space requirements and shipping limitations may also be considerations which result in deviation from the indicated curve. The curve is not extended below three rows since two-row or single-row bundles are, in general, not economically feasible.

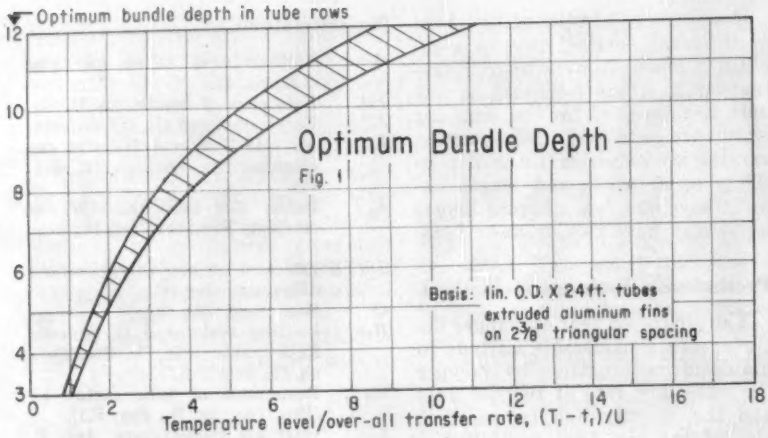
For the purpose of thermal calculations used in air-cooled heat exchanger design, air velocities are ordinarily based upon the face area of the tube bundle and upon standard air. The face area (FA) of the bundle is simply its length times the width. Standard air is defined as dry air at 70 F. and 29.92 in. Hg pressure, having a density of 0.075 lb./cu. ft. and a specific heat of 0.24 Btu./(lb., deg. F.). Using standard air as a basis, the product of face area in sq. ft. and the standard air face-velocity (FV) in ft./min. gives the total volume of standard air moving through a given size tube bundle. The temperature rise of the air can be calculated from the equation:

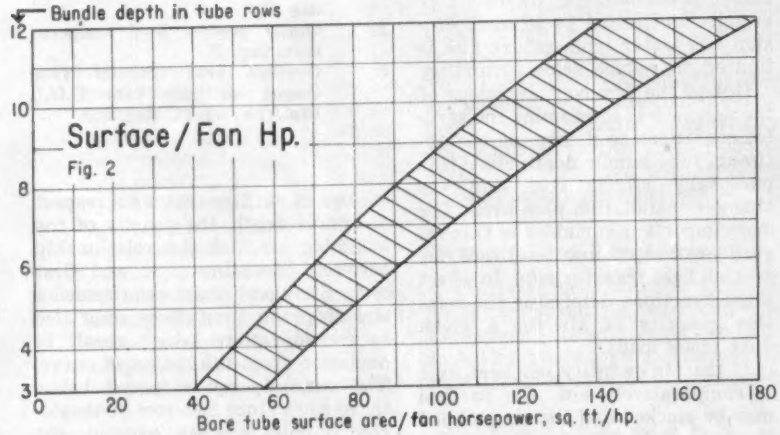
$$t_2 - t_1 = Q/(FA \times FV \times 0.075 \times 60 \times 0.24)$$
$$= Q/(FA \times FV \times 1.08)$$

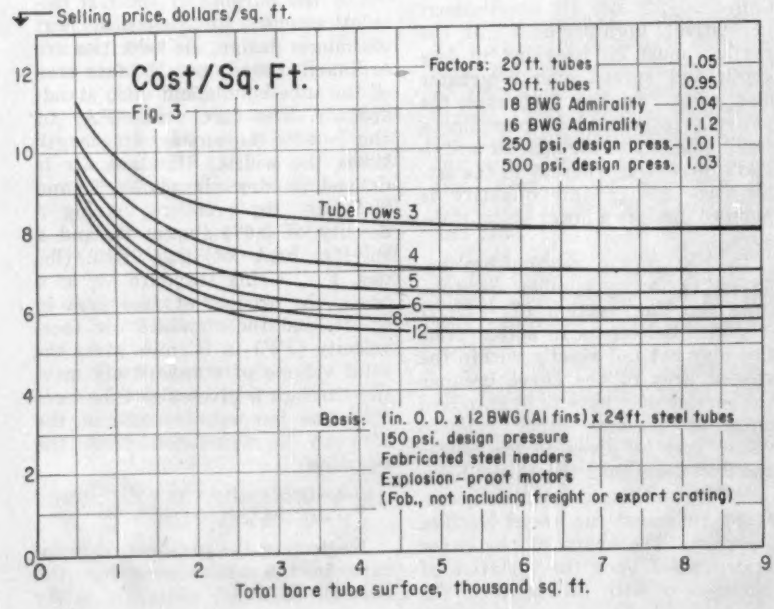
Neglecting the presence of moisture in the atmosphere has the over-all effect of adding a safety

Nomenclature

A	Surface area based on tube O.D., sq. ft.
FA	Face area of bundle, sq. ft.
FV	Face velocity of air, std. ft./min.
h_o	Air-side film heat transfer coefficient, Btu./(hr., sq. ft., deg. F.).
h_i	Inside film heat transfer coefficient, Btu./(hr., sq. ft., deg. F.).
$LMTD$	Effective log mean temperature difference, deg. F.
Q	Heat load, Btu./hr.
R_{if}	Fouling resistance of process fluid inside tube, 1/[Btu./(hr., sq. ft., deg. F.)].
R_m	Resistance of tube metal, 1/[Btu./(hr., sq. ft., deg. F.)].
t_1	Inlet air temperature, deg. F.
t_2	Outlet air temperature, deg. F.
T_1	Inlet process fluid temperature, deg. F.
T_2	Outlet process fluid temperature, deg. F.
U	Over-all heat transfer rate (based on bare tube O.D.), Btu./(hr., sq. ft., deg. F.).







factor to air-cooled heat exchanger design, since for a given amount of surface, fan power and heat load, the presence of moisture will reduce the air temperature rise thereby increasing mean temperature difference.

Additional data of value to the exchanger designer are the following estimating factors. The ratio of surface to face area is based on 1-in. O.D. tubing on 2⅞ in. triangular spacing.

Depth, tube rows	4	6	8	10	12
Unit weight, lb./sq. ft. *FA*	75	88	115	131	147
Typical *FV*, std. ft./min.	595	540	490	445	405
Sq. ft. surface/sq. ft. *FA*	5.04	7.60	10.08	12.64	15.20

The next step is to decide upon the proper selection of fan and fan driver. Driver output horsepower is calculated from the equation:

H.P. = [actual cu. ft./min. (at fan) × actual total press. (in. water)]/[6,356 × fan efficiency × drive efficiency]

The actual volume at the fan is calculated by multiplying the standard volume of air times the density of standard air (0.075 lb./cu. ft.) divided by the density of air at the fan. From this relationship it can be seen that the ratio of fan horsepower for a forced-draft unit as compared to that for an induced-draft unit is approximately equal to the ratio of the exit air density to the inlet air density. Neglecting the presence of water vapor, this horsepower ratio is also equal to the ratio of the absolute air temperatures $(t_1 + 460)/(t_2 + 460)$.

The total pressure across the fan is equal to the sum of the velocity pressure for the selected fan diameter plus the static pressure, which is determined from the equipment manufacturer's test data for a given finned tube and tube spacing. Fan diameters are selected to give velocity pressures of approximately 0.1 in. of water.

Industrial axial flow fans have total efficiencies of approximately 65%, and fan drives usually have a minimum of 95% mechanical efficiency. The design of the fan, the fan housing and air plenum chamber can materially affect the fan efficiency. The value of driver output horsepower must be divided by driver efficiency to determine input power. In all cases, efficiencies in the formula are expressed in fractions, or %/100.

Fig. 2 gives the sq. ft. of bare tube surface per driver output horsepower as a function of tube bundle depth. As in the case of Fig. 1, actual selections may deviate from the indicated area in the process of designing to standard units and because of different relative value being given to first cost and operating cost. Substantial increase in elevation above sea level—with a decrease in air density—will also cause an increase in relative fan power.

As in the case of other types of heat exchange equipment, the surface required is determined from the equation:

$$A = \frac{Q}{U \times LMTD}$$

From correlations presented in this paper, the surface, plan area, weight and horsepower requirements may be determined. The approximate selling price is shown in Fig. 3, which gives the price per sq. ft. of bare tube surface as a function of the total bare tube surface required for a given service, and the tube bundle depth. The prices indicated are F.O.B. factory prices and do not include freight or export crating.

The prices are based upon 1-in. O.D. x 12 BWG x 24 ft. long steel tubes with extruded aluminum fins, fabricated steel headers with steel shoulder plugs, 150 psig. design pressure and explosion-proof motors for fan drivers. Values are based upon V-belt drives for fan diameters to approximately 11 ft., and gear drives for larger diameter fans. Price multiplication factors are included for tube materials.

It can be seen from these curves that price per sq. ft. varies little for installations in excess of 5,000 sq. ft. of bare tube surface.

Making a Guesstimate

Here's a summary of the individual steps in estimating surface, horsepower, plan area and cost of air-cooled unit applications by means of information in this article.

1. From knowledge of the plant location and the process requirements tabulate Q, the heat load in Btu./hr.; the process fluid temperatures T_1 and T_2; the design ambient air temperature t_1; design pressure; tube material; and the type of service.

2. Refer to the table of typical over-all heat transfer coefficients and select a U for the particular type of service.

3. Calculate the value of $(T_1 - t_1)/U$ for this service, and from Fig. 1 read an optimum bundle depth in tube rows.

4. From the tabulation on p. 148, record the typical standard air face-velocity, the ratio of surface area to face area, and the ratio of weight to face area corresponding to the number of tube rows determined in step 3.

5. Now fixed are the over-all heat transfer rate, the tube bundle depth, the air face velocity and the relationship of surface, horsepower and weight to the face area. The exact surface requirement must then be determined by a trial and error process as follows:

- Assume an air temperature rise $(t_2 - t_1)$.
- Using the relationship, $FA = Q/[(t_2 - t_1) \times FV \times 1.08]$ calculate the total face area required.
- With the above assumed air temperature rise, both the fluid and air temperatures are now known and the log mean temperature difference ($LMTD$) may be calculated. If there is an obvious temperature cross, i.e., if the outlet air temperature t_2 is considerably above the required outlet fluid temperature T_2, and fluid side pressure drop is critical (number of tube passes is limited), it will be necessary to correct the $LMTD$ from $LMTD$ correction charts available in the literature for crossflow, both fluids unmixed. In most cases, this correction is negligible.
- Using the equation, $A = Q/(U \times LMTD)$, calculate the bare tube surface required.
- Divide this total surface by the ratio of surface area to face area determined from the table on p. 148, and compare this value of face area to that determined above.
- If the values of face area are not substantially equal, assume another air temperature rise and repeat the calculations above to determine the accurate value of surface A and face area FA required.

It is at this point that the experienced equipment designer will actually fix the number of tube passes and fluid mass flow velocity, confirm the assumed value of U, and check tubeside pressure drop.

6. The face area now determined is roughly equal to the plan area of the required installation. Divide the total face area by an assumed tube length to determine the plan dimension of the installation perpendicular to the direction of the tubes. Calculate the total fan horsepower requirement by dividing the total surface area A by the value of surface per horsepower obtained for the applicable bundle depth on Fig. 2. Determine the total approximate unit weight by multiplying the total face area by the weight per unit face area obtained from the table on p. 148.

7. Using the curves and tabulation on Fig. 3, find the unit cost per sq. ft. and calculate the total price.

Remember These Design Points

There are several other factors to keep in mind when designing air-cooled exchangers in addition to those already pointed out.

Maximum design temperatures as well as operating temperatures should be stated. If outlet fluid temperature is critical—requiring air flow regulation for temperature control—variable-pitch fans or shutters are available for air flow control.

From the standpoint of reducing power and operating costs, the use of automatically variable-pitch fans is preferable to using shutters or shutting off fans. The power required per pound of air moved is substantially fixed for a constant speed and constant pitch fan, but the power varies roughly as the air quantity cubed for a variable-pitch fan. Shutters are recommended only as an economy measure where a number of services requiring temperature control are combined in one unit.

In the case of long-range cooling of viscous liquids and low-pressure gases and condensation at very low pressures, the allowable pressure drop is a very critical requirement. This drop influences the necessary heat transfer surface, and possibly the length and diameter of the tubes. Although we've discussed primarily the use of 1-in. O.D. tubes, 1½-in. O.D. and larger tubing have been used in services such as flue gas and viscous-oil coolers.

The design ambient air temperature determines the approach of the cold fluid temperature—usually the limiting driving force in the

Changes in Variables Result in Different Exchanger Designs

The following three air-cooled exchangers were designed for the same service: desuperheat 365,000 lb./hr. of Freon 11 at 16 psig. from 180 F. and totally condense at 115 F. with ambient air available at 70 F. Heat load is 31.6 x 10^6 Btu./hr.

	Exchanger		
	X	Y	Z
Surface, sq. ft.	12,360	14,735	16,425
Plan area, sq. ft.	2,520	2,940	4,320
Tube rows	4	4	3
U, Btu./(hr., sq. ft., deg. F.)	68	60	58
Effective *LMTD*, deg. F.	37	36	33
FV, std. ft./min.	625	450	330
Air quantity, M std. cu. ft./min.	1,575	1,323	1,426
Fan horsepower	221	118	72
Price, dollars	85,100	95,600	116,400

heat exchanger design. Thus the choice of this temperature should be based upon reliable meteorological data for the particular plant location.

Choosing a particularly high figure for ambient temperature may result in unnecessarily large surface selection, and a figure which is too low may hamper plant operation during peak ambient air conditions if the fluid being cooled is a critical stream. Therefore some buyers specify the average daily maximum temperature for the hottest month of the year, while others use a temperature not exceeded more than 5% of the time during the three hottest months of the year.

Plant elevation or altitude becomes important in calculating fan horsepower since the horsepower is roughly inversely proportional to air density for a given weight rate of air flow.

To permit standardization of stores in a plant, the buyer may choose his own tube diameters and lengths. Aluminum has proved to be the most suitable fin material up to 500-550 F., and either bare-steel or steel finned tubes operate well above these temperatures.

Fan drivers can be either electric motors, steam turbines, gas engines or other types. Motor enclosure and speed preference (single or two-speed) are choices of the buyer.

Several additional specifications that the designer-buyer has at his discretion are: minimum number of tube bundles and fans per service; type of fan drive (V-belt or gear); plan area limitations; minimum elevation of exchanger outlet for pump suction or gravity drainage; space requirements beneath the air-cooled exchangers; fan-tip speed or noise-level limitations; operating power cost; capital pay-out time.

Which Fan—Forced or Induced?

In most cases the experience of the air-cooled exchanger manufacturer should dictate whether induced-draft or forced-draft designs should be utilized. Forced draft usually has a power advantage, especially if the temperature rise of the air is comparatively high. Forced-draft design permits a more convenient and economical mounting arrangement where a number of bundles and services are to be combined in a single unit.

Induced-draft design provides a more even distribution of air across the bundles, and for a given bundle elevation, affords more space for location of additional plant equipment beneath the unit. This design is more adaptable to suspension of the mechanical equipment from the unit itself, therefore making more suitable mounting the unit above a pipe rack or above shell-and-tube exchangers.

Induced-draft units are much less likely to recirculate hot exhaust air, since the exit air velocity is from two to three times that of a forced-draft unit. This fact becomes increasingly important in the case of a large heat exchanger installation, particularly one requiring a close approach of the fluid outlet temperature to the inlet air temperature. In most installations the advantages of induced-draft design outweigh the disadvantages, but the problem should be studied factually for each case.

Effect of Design Variables

Shown in the table at left are three selections of air-cooled exchangers for the same service. This illustrates the relationships of various design variables on the final size, shape and cost of unit.

Compare selections X and *Z*, noting that a three-fold reduction in fan horsepower is accompanied by a 35% increase in first cost, a 30% increase in surface and a 75% increase in plan area.

All exchanger services will show the same general trend in such comparisons. But each type of service (with its own over-all heat transfer rate and temperature level) will exhibit a different sensitivity to a change of air-side quantity and air-side transfer coefficient. A service with a low transfer rate and high temperature level is comparatively insensitive to changes in air quantity.

Surface requirements of a duty with low temperature level and high transfer rate increase rapidly with a reduction in design air quantity.

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Design Factors in Corrosion Control

- Avoid galvanic couples in equipment and structures.
- Avoid opportunities for concentration cells.
- Avoid localized stresses in materials of construction.
- Keep surfaces smooth and streamlined.
- Keep surface-to-volume ratios low.
- Specify strict fabrication standards and frequent inspection.

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IN DESIGNING structures and equipment for corrosive service, the job only begins with the selection of proper materials of construction and the specification of suitable environmental controls. Next the designer must apply his understanding of corrosion fundamentals intelligently to the details of his design and to the fabrication and erection procedures that he specifies. If this vital part of the job is not done well, costly design mistakes are likely to result.

Unfortunately mistakes of this kind are all too common. Many premature and unnecessary corrosion failures of plant equipment, buildings and transportation units have been traced directly to improper design.[1] Another significant cause of needless failures is poor workmanship[2] such as careless welding, machining, assembly or heat treatment. Improper design and poor workmanship go hand in hand since the need for careful fabrication and inspection may not be recognized unless specified by the designer.

Mears and Brown[3] pioneered in calling attention to proper design as a means of reducing corrosion losses. However, this subject has not been sufficiently emphasized in the literature.

Every major plant probably has a file of examples which could be used to illustrate our discussion. Many of these have been reported. A celebrated case[4] in the shipping industry is that of the yacht "Sea Call," built in 1915 with Monel hull plates fastened to steel frames with iron rivets. Galvanic corrosion rapidly destroyed the rivets and weakened the frames, causing the vessel to be scrapped after three months.

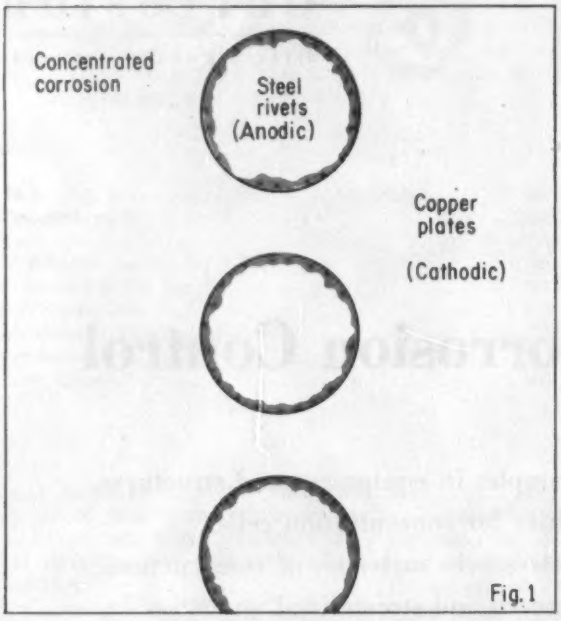
Fontana[5] describes perforation failure of a group of tanks caused by poor design. Here severe galvanic couples occurred between common steel walls and stainless steel clad bottoms. Goddard[1] cites the failure of power transformers in an aluminum reduction plant because copper cooling coils corroded. The corrosion of these coils could have been prevented by proper attention during plant design to water treatment requirements. Control instruments[6] are often designed without regard to corrosion principles. Failure of these auxiliary devices may be more serious than direct corrosion of process units and piping.

By observing six simple rules based on corrosion principles and sound engineering practice, we can avoid most design mistakes. The rules are: (1) avoid galvanic couples, (2) avoid opportunities for concentration cells, (3) avoid localized stresses, (4) keep surfaces smooth and streamlined, (5) keep surface-to-volume ratio low and (6) specify strict fabrication standards and provide frequent inspection during construction. Disregarding any of these rules can lead to costly failures.

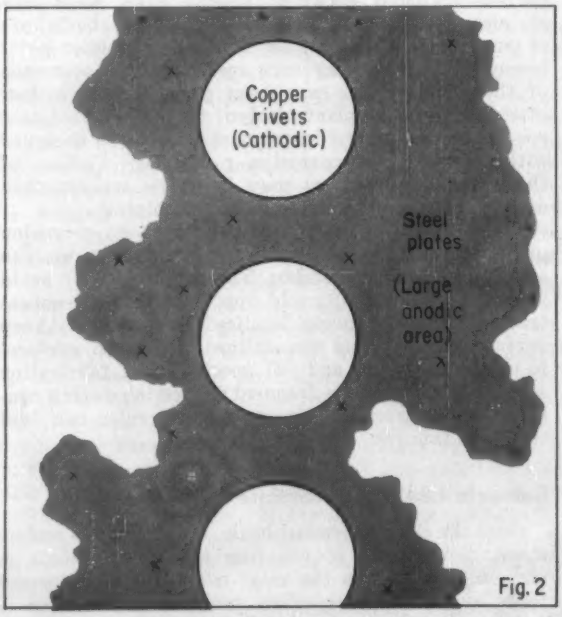
Galvanic Couples Accelerate Corrosion

Once the electrochemical basis of corrosion is understood, the danger of coupling dissimilar metals is obvious. Yet this is the most common type of error made by the designer, often, because his attention is focused on a particular detail. For example: to avoid valve corrosion, a noble metal may be used in a steel line without anticipating the accelerated pipe corrosion which is likely to result. Or as in the ship failure

Minimize Galvanic Action in Equipment



Galvanic couple forms between dissimilar metals and causes severe corrosive attack of the anode when the ratio of anodic to cathodic area is small.



Although galvanic couple still exists, ratio of anodic to cathodic areas is large. Hence severity of corrosive attack at anode is minimized by being spread over a larger area.

cited previously, a resistant structure may disintegrate because corrosion of its fastenings was not anticipated.

Two important factors establish the rate at which a dissimilar metal couple corrodes. These factors are the potential difference and the ratio of cathode to anode areas. As shown in Fig. 1 where the area of an anodic metal such as steel is small and the area of a cathodic metal such as copper is large, corrosion is rapid and intense. When the reverse is true as shown in Fig. 2, corrosion occurs but is less harmful. Potential differences may be reduced by natural or induced polarization effects. Since most galvanic corrosion processes are under cathodic control,[6] polarization at the cathode is preferable.

When bimetallic couples are necessary, the designer should try to select materials close together in the galvanic series. Exposed area of the less noble metal should be kept large relative to the more noble metal.

If a protective coating is to be applied, the more noble metal should also be covered, even though it is not expected to corrode. This latter point is well illustrated in the tank corrosion problem cited by Fontana.[5] As shown in Fig. 4 galvanic action, between the large area of a cathodic stainless steel bottom and the tiny areas of anodic common steel wall exposed through pinholes in the coating, causes intense corrosion, pitting and perforation failure. This problem was solved by coating the tank bottoms and blocking off cathode areas.

Large potential differences are sometimes unavoidable, as in the use of sheet aluminum over steel structural frames, or brass fittings in steel piping. In such cases, electrical insulation should be provided at connection points by using non-metallic washers, gaskets and nipples. May[6] points out that in small diameter piping the electrical resistance of liquids restricts galvanic action principally to locations within two or three pipe diameters of a joint. This restriction makes possible the use of waster-nipples four to six diameters in length which are inserted adjacent to joints. Hence, the nipples are accessible for periodic replacement.

An aspect of galvanic action which must not be ignored is deposition corrosion.[1] This is a secondary process resulting from ionic displacement and precipitation of noble metals on a more active metal surface. At points of deposition, local galvanic couples form. An example is the deposition of dissolved copper on galvanized or aluminum tank surfaces. This type of attack can be avoided by not using base metals downstream from more noble metals.

Consider Stray Currents and Concentration Cells

Care should be taken to avoid stray currents likely to induce electrochemical corrosion on structures or equipment carrying electric current. Locations at which piping and vessel supports are grounded are most vulnerable. Structures may be weakened by solution of metal or more commonly through disruption of joints or concrete footings by accumulated bulky corrosion products. Though preventive precautions for proper insulation are provided in design, new installations should be tested in actual operation for stray currents upon startup and periodically thereafter.

The many joints normally required in all equipment and structures provide ready opportunities for con-

centration cells and crevice corrosion. As we pointed out earlier,[7] intensified attack can occur at local anodes in crevices on both inside and outside surfaces of equipment. The designer should studiously avoid crevices by using welded joints in preference to bolted or riveted joints whenever practical. Unavoidable crevices may sometimes be caulked or sealed with an organic compound. To be effective, sealing must be done properly with non-destructive materials.

Not only metal-to-metal joints are dangerous but contacts involving non-metallic materials such as plastics, wood or fabrics require careful attention during design and fabrication. Moisture-retaining materials and compounds containing potentially corrosive components should be avoided. Adhesives must be serviceable under projected exposure conditions and carefully applied. Pinholes and other coating defects should be minimized.

Opportunities for the collection of concentrated solutions and corrosive components at inaccessible points in liquid carrying equipment must be minimized. For example, provide for complete drainage of tanks. Avoid pockets in which stagnant liquids can accumulate as behind baffles or thermowells in reactors and heat exchangers. Connecting nipples must not project into vessels and tanks. The importance of these considerations in refiner design is discussed by Johnson and Daniels[8] and by Nelson.[9]

Crevice corrosion can be particularly troublesome in heat transfer equipment of conventional design and construction. Recently all-welded heat exchangers have been introduced as high-pressure feedwater heaters. This method of fabrication avoids bolt and gasket head construction and tube rolling. Several such units have been in service[11] over nine years at 3,600 psi. and 800 F. The design principles used here may be applicable to other types of corrosion-resistant equipment.

Localized Stress Intensifies Corrosion

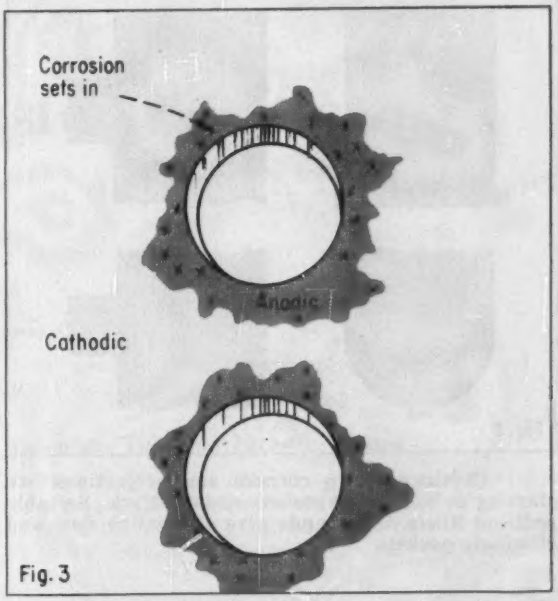
Promotion of corrosion by localized stresses can be demonstrated by the simple experiment of immersing a clean common nail into a gelatin solution containing ferricyanide and phenolphthalein indicators. The head and point of the nail, cold-worked during manufacture, are clearly anodic as shown by the blue color developed in the surrounding areas by the ferricyanide solution. Along the cathodic shank of the nail, hydroxide ions color the phenolphthalein red.

In a similar way localized stresses in any metal structure as shown in Fig. 3 intensify corrosion. Even under reasonably normal stress distribution some materials are prone to stress corrosion.

Consequently the designer should take every practical precaution to avoid uneven stress distribution in structures exposed to corrosive conditions. Where these are likely to arise in welding, machining or other fabrication steps, stress relief through heat treatment should be specified. This practice requires that vessels, towers and other process units be shop-assembled, annealed and then properly inspected by X-ray techniques. The subsequent transportation expense for large pieces of equipment is more than justified by longer service.

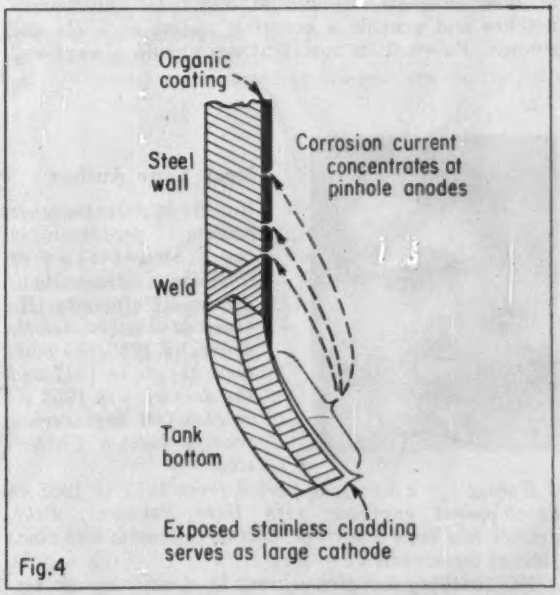
In field assembly and repairs, heat treatment to relieve stresses is not practical. Here, special alloys[6] must be used which do not undergo undesirable metal-

Localized Stress Creates Potential Anodes



Drilling of bolt hole sets up unequal stress distribution in steel plate. Area surrounding opening becomes anodic and is thus susceptible to attack in corrosive environment.

Incomplete Coatings May Cause Corrosion



Pinholes in protective coatings subject underlying metal to severe pitting if a large area of a more noble uncoated metal functions as cathode.

Keep Surfaces Smooth and Streamlined

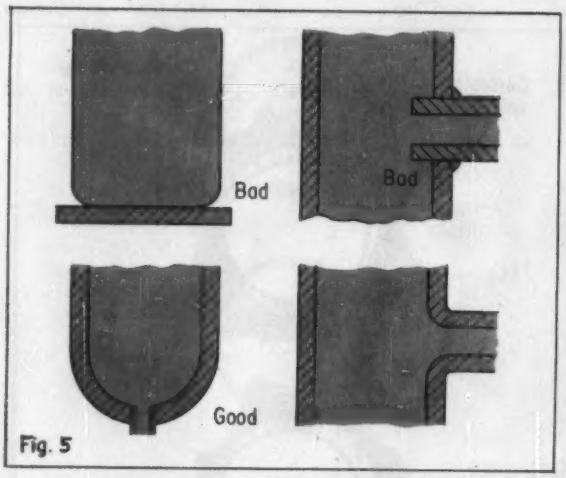


Fig. 5

Crevices, sharp corners and projections are starting points for corrosion-erosion attack. Suitable radii on fillets and rounds give streamline flow and eliminate pockets.

lurgical changes during welding or resist stress corrosion effects.

Surface Smoothness and Streamlining

As mentioned earlier in this series,[7] rough areas are more susceptible to corrosion than smooth surfaces. Likewise projections and sharp corners provide good starting points for corrosion-erosion failures. Consequently the designer should strive for streamlining of flow channels. He should eliminate unnecessary notches and provide a generous radius at fillets and rounds. Fabrication specifications should always call for finishing of rough joints, weld beads and pipe burrs. Through experience and careful attention to detail, the designer learns how to avoid these potential troubles.

Surface-to-Volume Ratio Controls Corrosion

As with all surface reactions, corrosion rate increases as the ratio of exposed surface to metal volume is increased. This factor can be most important in designing some equipment and structures. Goddard[1] refers to the failure of aluminum screen wire in a marine exposure which does not materially affect aluminum sheet having the same thickness as the wire. Stranded wire is also known to corrode more rapidly than a single piece of equal diameter. Thus the corrosion engineer seeks to minimize surface-to-volume ratio, especially in the case of thin sections.

Fabrication and Inspection Standards

No design practice is effective unless proper steps are taken to ensure compliance with resultant specifications. While the major duty here rests with the fabricators, the designer is responsible for calling attention to critical specifications and preferred manufacturing practices. These should include special inspection procedures and criteria as required.

Experience in different industries has led to the establishment of design standards for certain kinds of equipment and to the publication of preferred practice guides. In the former category a number of reports have been published by special committees of the National Association of Corrosion Engineers. One such report is the recent construction standards[11] for lined acid-proof vessels. In a series of articles, Hoover[12] summarizes design standards for lead installations.

In the category of practice guides, Dolan[13] discusses stress elimination in the design and fabrication of pressure vessels. Rudolph[14] covers the minimization of atmospheric corrosion in structural design. Munger[15] suggests preferred design practices relative to protective coatings. Collins[16] analyzes the effect of design, fabrication and installation on the performance of stainless steel equipment.

Finally, we should point out that no set of rules or practice guides can insure faultless design or cover every possible contingency. The good designer must be conscientious and ingenious in finding and solving new problems. These characteristics require a thorough understanding of technical fundamentals, tempered with considerable experience.

Meet Your Author

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Except for a two-year period from 1951 *to* 1952 *as development engineer with Esso Research, Prof. Jelinek has been a teacher, first at Columbia and since* 1954 *at Syracuse.*

His teaching includes courses in chemical processes, plant design, corrosion and electrochemistry, thermodynamics and unit operations. His current research work is corrosion and mass transfer in liquid metals.

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New Aids to Find

Tubeside Heat Transfer Coefficient

And Pressure Drop for Water

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FOR THE important reason that water is a very common heat transfer medium, the preceding short-cut methods in this series have been converted specifically to physical properties of water, and in this article, to the case where water is inside the tubes. Other charts and nomographs[2, 3] have done the same thing.

How to Find Heat Transfer Coefficients

Find the heat transfer coefficient for water flowing through a 1-2 heat exchanger with 292, ¾ in. x 14 BWG tubes (2 tube passes), at a rate of 175,000 lb./hr. and at 100 F., isothermally.

Step 1—Mass velocity G' from Fig. 1 in a prior article[1] is 160 × 1.13 = 180 lb./(sec., sq. ft.)

Step 2—Enter Fig. 1 at $G' = 180$, drop a vertical line to 100 F., and follow the sloping guide line to read $h_{io} = 680$. Correct this for tube size, so that $h_{io} = 680 \times 0.952 = 647$ Btu./(hr., sq. ft., deg. F.).

This method is based on the equation[4] given as: $(h\ D/k) = 0.023\ (D\ G/\mu)^{0.8}\ (C\mu/k)^{0.4}$. For water between 40 F. and 220 F. the physical properties may be represented as functions of temperature; and the coefficient can be based on outside tube area. This equation—basis of Fig. 1—results: $(h_{io}D_o') = 5.6\ (1 + 0.011\ t)\ (D'\ G')^{0.8}$.

Calculate Tubeside Pressure Drops

Find the pressure drop for water in turbulent flow at a rate of 150,000 lb./hr. and at 90 F., isothermally, through the tubes of a 1-2 exchanger having 290, ¾ in. x 14 BWG tubes (2 tube passes). (*Continued*)

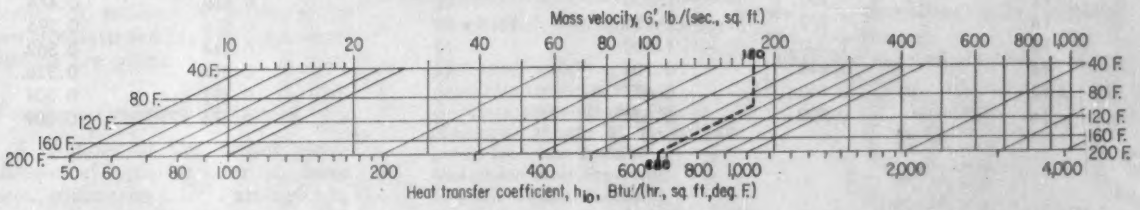
* To meet your author, see *Chem. Eng.*, June 30, 1958, p. 140.

Nomenclature

C	Specific heat, Btu./(lb., deg. F.).
D	Inside tube diameter, ft.
D'	Inside tube diameter, in.
G	Mass velocity inside tube, lb./(hr., sq. ft.).
G'	Mass velocity inside tube, lb./(sec., sq. ft.).
h	Heat transfer coefficient (based on internal surface), Btu./(hr., sq. ft., deg. F.).
h_{io}	Heat transfer coefficient for water (based on outside surface), Btu./(hr., sq. ft., deg. F.).
k	Thermal conductivity, Btu./(hr., sq. ft., deg. F./ft.).
L	Length of travel, ft.
t	Water temperature, deg. F.
$\Delta P'$	Pressure drop, lb./sq. in.
μ	Viscosity at average fluid temperature, lb./(hr., ft.).

Heat Transfer Coefficients for Water Inside Tubes

Fig. 1



Tube Size Correction Factors for Heat Transfer Coefficients

Tube Size	Factor	Tube Size	Factor	Tube Size	Factor
¾" x 10 BWG	0.818	1" x 10 BWG	0.860	1¼" x 8 BWG	0.820
12	0.887	12	0.904	10	0.870
14	0.952	14	0.950	12	0.900
16	1.000	16	0.984	14	0.935
18	1.042	18	1.010	16	0.965

Four Conversion Charts Help Find Corrected Pressure Drop

Read $\Delta P'/L$ for your G′ value. Multiply by temperature correction and tube size factors.

. . . For Turbulent Flow

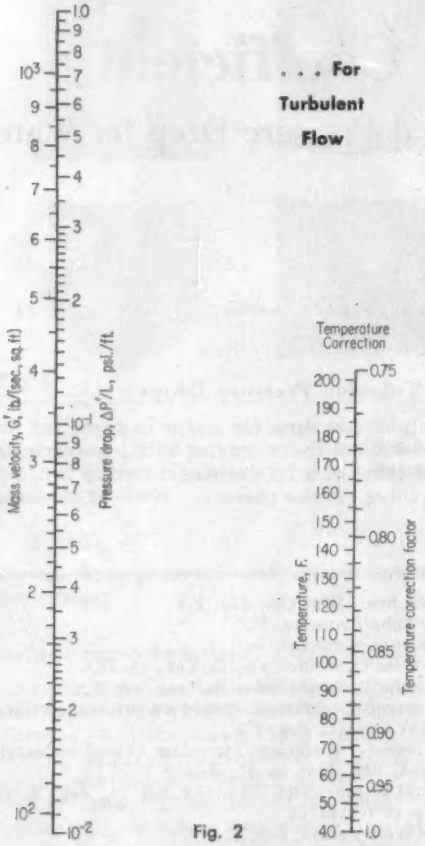


Fig. 2

Tube Size	Factor Turbulent	Factor Streamline
¾″ x 10 BWG	1.352	1.650
12	1.200	1.350
14	1.072	1.130
16	1.000	1.000
18	0.940	0.904
1″ x 12	0.758	0.627
14	0.702	0.553

. . . For Streamline Flow

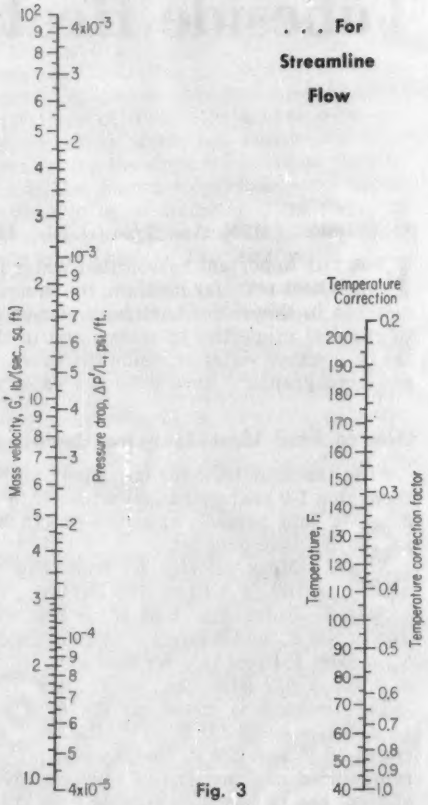


Fig. 3

Tube Size	Factor Turbulent	Factor Streamline
1″ x 16 BWG	0.665	0.505
18	0.640	0.474
1¼″ x 10	0.576	0.396
12	0.544	0.362
14	0.514	0.328
16	0.491	0.304
18	0.476	0.289

Step 1—Mass velocity G' from Fig. 1 in a prior article[1] is 138 × 1.13 = 155 lb./(sec., sq. ft.).

Step 2—From the appropriate line in Fig. 2 read the temperature correction factor as 0.87 at 90 F., and the uncorrected pressure drop as 0.025 at G' = 155. For a tube size correction factor of 1.072 and a safety factor of 1.2 (assumed), the pressure drop $\Delta P'/L = 0.025 \times 0.87 \times 1.072 \times 1.2 = 0.028$ psi./ft.

Relationships for pressure drop through tubes for any fluid in turbulent or streamline flow have been developed in preceding articles[5, 6] in this series. The equations have been expressed in terms of physical properties of water, which can be related to temperature, and simplified charts drawn as shown here.

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How to Estimate Engineering Properties

To Get Viscosity for a Gas Mixture

Since the viscosity of a gas mixture can vary very irregularly you'll find these prediction methods to be most convenient.

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At a given temperature and pressure, the viscosity of a mixture of gases can vary with composition in a highly irregular fashion.

For many binaries, in fact, the viscosity of certain compositions may be greater than the viscosity of either component, the viscosity-composition curve passing through a maximum (this is especially characteristic of mixtures containing H_2).

In previous articles (*Chem. Eng.*, Sept. 22, 1958, p. 169; and Oct. 20, 1958, p. 157) we have already considered how to estimate the viscosity of a gas and how to correct for the effects of temperature and pressure. We'll discuss in this article the various estimation methods with which mixture viscosities may be calculated from known pure-component viscosities. Separate treatments of estimation methods for low-pressure and high-pressure conditions are given.

For Low-Pressure Mixtures

A number of the earlier semi-theoretical equations for μ_m have been summarized by Partington[43]; included are the fairly accurate proposals of Sutherland,[45] Thiesen,[46] Puluj[47] and Enskog.[48]

More recent extensions[2, 4, 21] of the kinetic theory have resulted in rather complicated but highly accurate (½-1% error) equations for the viscosities of nonpolar binary gas mixtures at low pressure. One simple special case is that of binary mixtures of heavy isotopes, for which M_2/M_1 approaches unity:

$$\mu_m = \frac{\mu_1\mu_2}{[\mu_1^{0.5}y_2 + \mu_2^{0.5}y_1]^2} \qquad (40)$$

The rigorous theory has been extended to mixtures containing three or more components by Curtiss & Hirschfelder.[37, 4]

A simpler, but less rigorous, μ_m equation was developed by Buddenberg & Wilke[20] from the early Sutherland-Thiesen type relation.[45] Their equation may also be obtained from the modern rigorous theory by an empirical simplification of the determinants which appear in the rigorous theory. By an extensive analysis of experimental data, Buddenberg & Wilke assigned an empirical value to a constant in their equation and wound up with a relatively simple and accurate correlation for μ_m, for which the average error for 35 gas mixtures was $\cong 2.2\%$.

Principal disadvantage of this method is that it requires knowledge of binary diffusion coefficients of the various gas pairs in a multicomponent mixture. The diffusion coefficients must often be estimated in turn from other prediction procedures, and the over-all accuracy of the method usually suffers as a result.

Nomenclature

k	Boltzmann's constant, ergs/deg.-K.
M	Molecular weight.
P	Absolute pressure, atm.
T	Absolute temperature, deg. K.
V_b	Molecular volume at the boiling point, cc./gram-mole.
y	Gas-phase mole fraction.
z	Compressibility factor.
ϵ	Maximum energy of molecular attraction, ergs.
μ	Gas viscosity, micropoises.
ρ	Gas density.
ϕ	See Eqs. (42) and (43).
Subscripts	
b	At the normal boiling point.
c	At the critical point.
i	For the i-th component.
m	For a gas mixture.
r	Reduced property.
12	For a mixture of components 1 and 2.

We Recommend This One

Wilke[20] accordingly modified the earlier relation[45] and obtained a general equation for μ_m as a function of the pure-component molecular weights, viscosities, mole fractions and densities:

For the sake of simplicity, if we let,

$$\mu_1/\mu_2 = a$$
$$\mu_2/\mu_1 = b$$
$$\rho_1/\rho_2 = c$$
$$\rho_2/\rho_1 = d$$
$$M_1/M_2 = f$$
$$M_2/M_1 = g$$

Then,

$$\mu_m = \frac{\mu_1}{1+(y_2/y_1)\phi_{12}} + \frac{\mu_2}{1+(y_1/y_2)\phi_{21}} \qquad (41)$$

where,

$$\phi_{12} = \frac{[1+(ad)^{0.5}(f)^{0.25}]^2}{[4/(2)^{0.5}][1+f]^{0.5}} \qquad (42)$$

$$\phi_{21} = \frac{[1+(bc)^{0.5}(g)^{0.25}]^2}{[4/(2)^{0.5}][1+g]^{0.5}} \qquad (43)$$

and where pure component densi-

* To meet your author, see *Chem. Eng.*, Feb. 10, 1958, p. 173.

ties, ρ, are to be evaluated at mixture temperature and total pressure.

For ideal gas behavior, Eqs. (42) and (43) reduce to the following equations:

$$\phi_{12} = \frac{[1+(a)^{0.5}(g)^{0.25}]^2}{[4/(2)^{0.5}][1+f]^{0.5}} \quad (44)$$

and,

$$\phi_{21} = \frac{[1+(b)^{0.5}(f)^{0.25}]^2}{[4/(2)^{0.5}][1+g]^{0.5}} \quad (45)$$

To facilitate use of Eq. (41), Bromley & Wilke[8] presented plots of ϕ as a function of μ_1/μ_2 and of M_1/M_2 for a range of values. These graphs are given here as Figs. 1 and 2 and they may be used in place of Eqs. (44) and (45). Average error of Eq. (41) in representing μ_m for 17 binary gas systems was only 0.97%; excluding H_2-A, for which agreement was least satisfactory, the avg. deviation was reduced to 0.49%.

In the computations to which these error figures apply, experimental pure-component viscosities were used. Use of calculated pure-component viscosities would usually increase the error somewhat.

A general μ_m equation for multicomponent gas systems was also given by Wilke[69]; a comparison with data for 13 systems of 3 to 7 components, including industrial gases, gave an avg. error of 1.9%. For these equations and an example of their application to a seven-component gas mixture, we refer you to the original Bromley & Wilke paper.

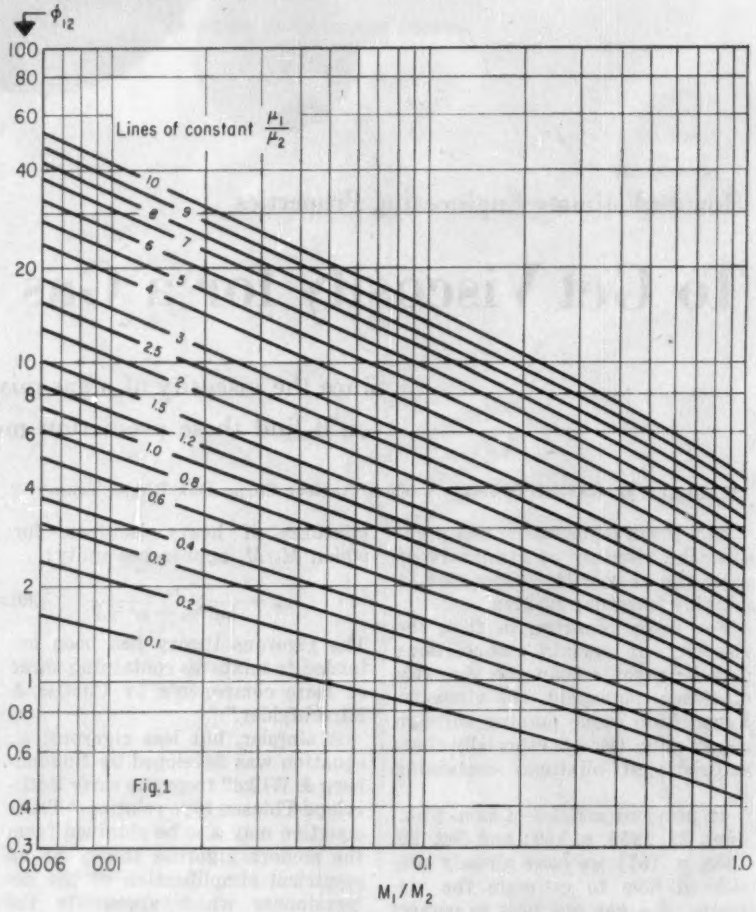
Later, Buddenberg and Wilke[70] presented new μ_m experimental data and affirmed the excellence of the rigorous but complicated modern kinetic theory approach.[39, 4] They also tested the simple Schudel[71] equation, a single-constant form of the earlier Sutherland relation:[68]

$$\mu_m = \frac{\mu_1}{1 + C(y_2/y_1)(\mu_1/\rho_1)} + \frac{\mu_2}{1 + C(y_1/y_2)(\mu_2/\rho_2)} \quad (46)$$

where pure-component densities are evaluated at mixture temperature and total pressure, and where C is a constant for all compositions of a given gas pair at a specified temperature and pressure.

Eq. (46) gave an avg. error of 0.6% for 16 compositions of five gas pairs when the constant C was evaluated by trial from the data so as to give a minimum deviation.

For Molecular-Weight Ratios, Be They Low . . .



Also Recommended

A simple relation for μ_m that is often used in the chemical process industries is that of Herning & Zipperer:[72]

$$\mu_m = \frac{\Sigma y_i \mu_i (M_i)^{0.5}}{\Sigma y_i (M_i)^{0.5}} \quad (47)$$

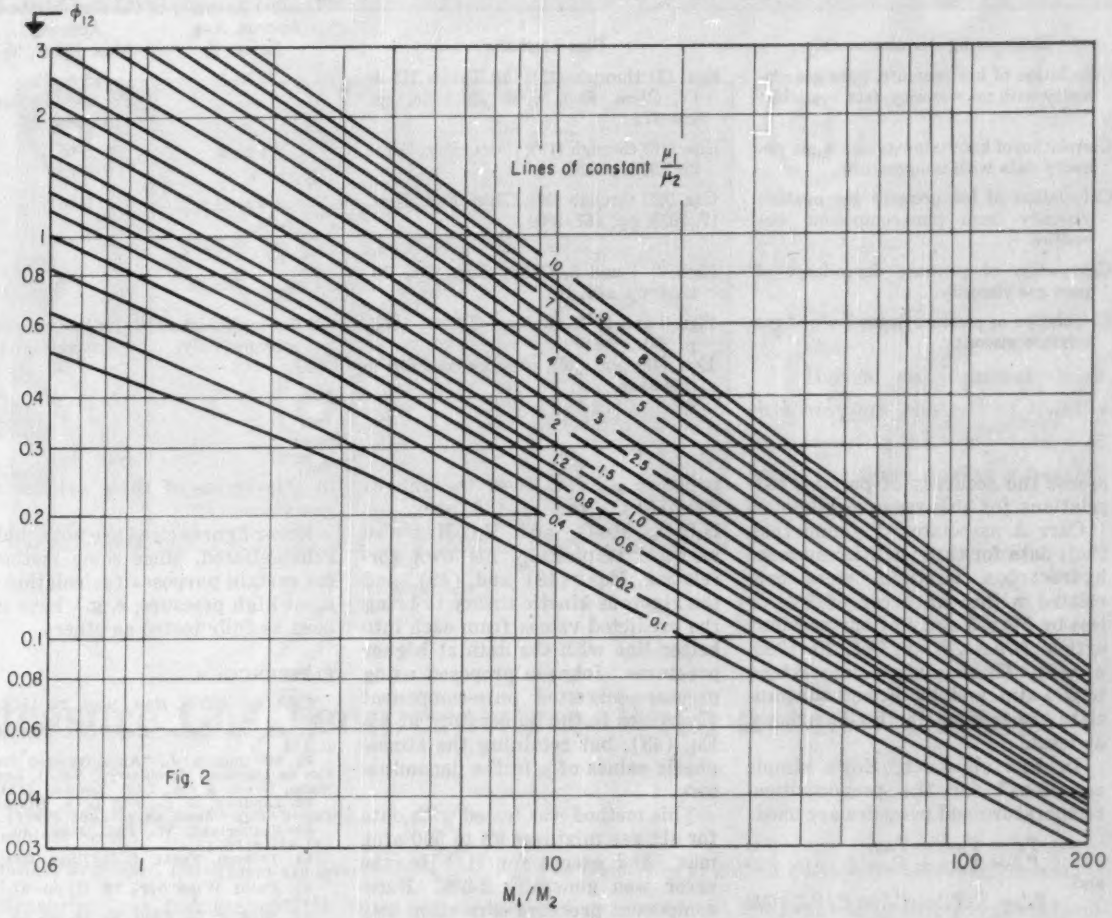
This correlation, often called the "square-root rule," is the simplest accurate rule available. A test by Schmid[73] on 25 industrial multicomponent mixtures gave an avg. error of 1.9%. Later tests by Carr and coworkers[39, 40] with all available hydrocarbon-mixture data, including their own, indicated that Eq. (47) was accurate within measurement precision; max. error was about 1.5%. Eq. (47) has also been recommended by Maxwell[74] for hydrocarbon mixtures.

Friend & Adler[75] have pointed out that for gas mixtures with a H_2 content in excess of about 25%, other methods such as Wilke's Eq. (41) are preferable to Eq. (47). Errors are generally <3% for small H_2 contents, but may reach 1.0% for H_2-rich mixtures. Though Eq. (47) allows for nonlinear isotherms, it does not allow maxima in viscosity-composition curves. It's probably for this reason that Eq. (47) is not as accurate for mixtures containing H_2, since such mixtures often exhibit maxima.

Proposed By Johnson

A proposal by Johnson[67] gives good agreement for μ_m of binary gas mixtures at low pressure, but is of more concern here in connection with gas mixtures at high pressure,

. . . or High, These Bromley-Wilke Charts Replace Eqs. (44) and (45).



a case which is discussed in a separate section below.

Johnson's proposal may be stated this way:

$$\mu_m = \frac{\mu_1}{1 + [y_2/y_1][f(A)\mu_1 z_1/M_1 T^B]} + \frac{\mu_2}{1 + [y_1/y_2][f(A)\mu_2 z_2/M_2 T^B]} \quad (48)$$

where

$$f(A) = [0.00032(\epsilon_{12}/k)^{1.227} \times (V_{b1}^{1/3} V_{b2}^{1/3})^2 \times (M_1 M_2)^{1/2}]/(M_1 + M_2)^{1/2} \quad (49)$$

where μ_1 and μ_2 are viscosity at T deg. K., micropoises; z_1 and z_2 are compressibility factors ($\cong$ 1.0 at low pressure); B is a function of k/ϵ_{12} to be obtained from Fig. 3.

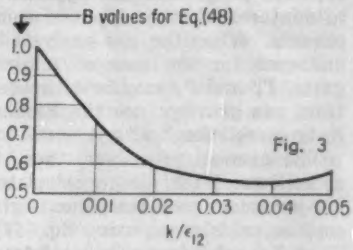
Molecular volume at the normal boiling point, V_b, may be calculated for the components by summing the additive contributions as published earlier in this series. The factor (ϵ_{12}/k) may be estimated from Eqs. (6) or (13) and the equation:

$$\frac{\epsilon_{12}}{k} = \left(\frac{\epsilon_1}{k} \cdot \frac{\epsilon_2}{k}\right)^{0.5} \quad (50)$$

or may be calculated from Table II (*Chem. Eng.*, Sept. 22, 1958, p. 170) and Eq. (50).

Andrussow[35] has also published correlations for the calculation of low-pressure μ_m.

The equation of Johnson, Huang & Kemp (*Chem. Eng.*, Sept. 22, 1958, p. 171 Table III) may be used with fair success for low-pressure gas mixtures. The maximum error for seven systems was $\cong$ 12%; for mixtures containing CO_2, the method is not satisfactory. In using this equation, pseudocritical temperature and pressure, Eqs. (51) and (52), and the avg. molecular weight should be used.



For High-Pressure Mixtures

Relatively few reliable data are available for gas mixtures of high density. Therefore, it's difficult to

Over-All Summary of Today's Best Estimation Methods for Gas Viscosity

Engineering Requirements	Best Methods	General Accuracy of the Best Methods: Approx. Avg. Error, %	General Accuracy of the Best Methods: Approx. Max. Error, %
Calculation of low-pressure, pure gas viscosity with no viscosity data available.	Eqs. (3) through (15) and Tables III & IV, *Chem. Eng.*, Sept. 22, 1958, pp. 169–172.	3 to 5	15 to 25 (For highly polar compounds)
Correlation of known low-pressure gas viscosity data with temperature	Eqs. (16) through (19), *Chem. Eng.*, Sept. 22, 1958, p. 157.	1 to 2	5 to 6
Calculation of low-pressure gas mixture viscosity from pure-component viscosities.	Eqs. (41) through (49), *Chem. Eng.*, Nov. 17, 1958, pp. 157–160.	1 to 2	3 to 6
Calculation of pressure dependence of pure gas viscosity.	Figs. 3, 4 and 5, *Chem. Eng.*, Oct. 20, 1958, pp. 160, 161.	2	8
Calculation of pressure dependence of gas mixture viscosity.	Figs. 3 and 4, *Chem. Eng.*, Oct. 20, 1958, p. 160. Eqs. (48) and (49), pressure modified in this issue.	2 (for hydrocarbon mixtures only) 1	8 (for hydrocarbon mixtures only) 4

assess the accuracy of possible correlations for this case.

Carr & associates[46, 47] found that their data for three multicomponent hydrocarbon mixtures were correlated within an error of 8% or less by Figs. 3 and 4 of our previous article (*Chem. Eng.*, Oct. 20, 1958, p. 160). These mixture data extend to 680 atm. and 220 F. and substantiate the method for hydrocarbons, at least.

In this approach, Kay's simple equations[48] for the pseudocritical temperature and pressure are used:

$$T_c' = T_{c1}y_1 + T_{c2}y_2 + \cdots \quad (51)$$

$$P_c' = P_{c1}y_1 + P_{c2}y_2 + \cdots \quad (52)$$

and

$$T_r' = T/T_c'; \quad P_r' = P/P_c' \quad (53)$$

Though Kay's equations were based originally on hydrocarbon data only, it was later demonstrated[49] that (for *P-V-T* relations, anyway) they were also applicable to mixtures of other types of components. When the gas analysis is unknown for the case of natural gases, T_c' and P_c' may be estimated from gas gravity (see the Bicher-Katz correlation,[78] e. g.).

The over-all procedure, then, is as follows: With known calculated low-pressure pure-component viscosities, calculate μ_m using Eq. (47). Then T_c' and P_c' are calculated from Eqs. (51) and (52); next Eq. (53) is used to compute the pseudoreduced temperature and pressure. Entering Figs. 3 and 4 (see reference above) with calculated T_r' and P_r', one obtains μ_P/μ_1; this ratio times the previously calculated low-pressure mixture viscosity then gives the final result.

Johnson,[77] who obtained high-pressure μ_m data over the ranges 200-450 C. and 20-136 atm. for H_2O-O_2, He-O_2 and H_2O-He, also modified empirically his own correlation, Eqs. (48) and (49), and the rigorous kinetic theory to bring the predicted values from each into better line with the data at higher pressures. Johnson proposed using pressure-corrected pure-component viscosities in the numerators of his Eq. (48), but retaining the atmospheric values of μ in the denominators.

This method was tested with data for six gas mixtures up to 500 atm. max., and except for H_2O-He, the error was generally 2-3%. Pure-component pressure correction may be made by using the Figs. cited above.

Wilke's Eqs. (41) to (43) contain density terms and would apparently apply to the nonideal gas state; but to the writer's knowledge, no tests of these equations with high-pressure μ_m data have been made.

Kay's rules for the pseudocritical temperature and pressure have also been used with the Uyehara-Watson chart[24, 25] for correlation of high-pressure μ_m data. For this case, however, the Carr and Johnson methods are recommended. The Uyehara-Watson method gives about a 6% avg. error at low pressure and 10% at higher pressures.

Over-All Summary Chart

The table above gives the approximate general accuracies to be expected for the five major areas of calculation when using the best methods of those we have discussed in this series of three articles on gas viscosity.

Error figures cited are not equally substantiated, since some methods for certain purposes (calculation of μ_m at high pressure, e. g.) have not been as fully tested as others.

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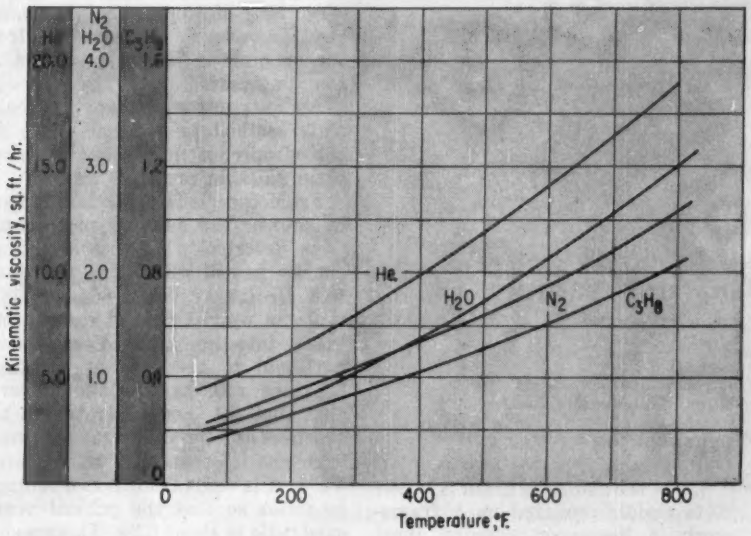


Here's an unusual trick that may get you out of trouble in measuring the temperature of small gas flows during a heating or cooling process.

Measure Gas Temperatures With a Flow Meter

★ **Winner of the September Contest by**
Donald S. Scott

Associate Professor, Department of Chemical Engineering, The University of British Columbia, Vancouver, Canada.

Measuring gas temperatures at very small flow rates or at very low gas velocities presents serious difficulties. Both thermocouples and thermometers may be subject to large radiation errors which cannot be made sufficiently small, even with the assistance of high-velocity jets, or radiation shielding, or combinations of both.

If this small gas flow is being heated or cooled, there is no simple primary measuring instrument which can readily be used to give a close estimation of its temperature and do so with any degree of certainty.

However, there is a trick which will overcome this difficulty if we have the means for measuring the gas flow rate closely. The principal limitation on accuracy of this method lies in the error in measuring the flow rate and in holding it constant.

A conventional flow meter of the capillary or rotameter type can be used. If the gas is then passed at a known flow rate through a second suitable capillary installed at some point in a heating or cooling process, Poiseuille's relationship can be used, together with the pressure drop across the capillary, to find the kinematic viscosity of the gas at this point. Since kinematic viscosity is a fairly sensitive function of temperature, and is known over a wide range for many gases and vapors, this gives a method for finding temperature with a good degree of accuracy.

The Poiseuille formula is:

$$\frac{\mu}{\rho} = \frac{\pi g \Delta P D^4}{128\, WL} \qquad (1)$$

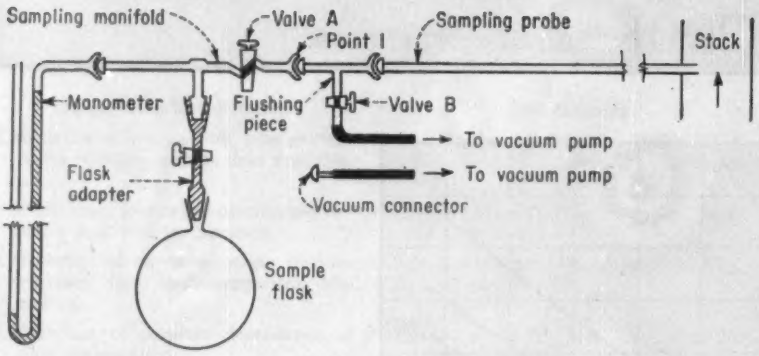
where μ/ρ is kinematic viscosity, sq. ft./sec.; ΔP is the pressure drop across the capillary, in lb./sq. ft.; D is the diameter of the capillary, ft.; W is the mass rate of flow, in lb./sec.; and L is the capillary length, ft. The chart above shows the variation in kinematic viscosity for four widely different gases from 0 to 800 F.

A flow meter made of pure silica capillary tubing has been used to estimate gas temperatures to an accuracy of ±5 F. over the range of 60 to 600 F. Pure silica greatly minimizes errors due to dimensional changes of the capillary but other materials can be used if suitable corrections are made by trial and error for dimensional changes.

Since several of the quantities in the equation will be constant for a given capillary flow meter, it is usually convenient to determine a "geometric" factor for the capillary by carrying out measurements at one known temperature, such as room temperature. Then the working equation becomes

$$\mu/\rho = k\Delta P/W \qquad (2)$$

where k is a constant determined at room temperature. This minimizes errors due to non-uniformity of capillary diameters.



Collecting Integrated Gaseous Samples

Richard S. Brief* and Philip A. Drinker

Public Health Service, U. S. Dept. of Health, Education and Welfare
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

In connection with an air pollution survey conducted by the Public Health Service it was necessary to sample the gaseous organic effluents from a synthetic rubber plant. These wastes were vented through stacks both cyclically and continuously and we needed a sampling method which could secure an integrated 2-liter sample over a period of up to 2 hr.

We decided to use all-glass equipment to avoid possible reactions with the sample and minimize changes in sample composition after collection. This was important since these samples were to be sent to the National Bureau of Standards in Washington for mass spectrographic analysis, involving a considerable time lag.

The diagram shows the sampling train which consists of a 2-liter round-bottom flask sealed by a stopcock in a flask adapter. The adapter connects to a manifold, one end of which is joined to a mercury manometer, the other end terminating in the flushing, sampling and vacuum system. The stopcock labeled Valve *A* is used to control the rate of sample flow. Valve *B* is used in purging the train up to Valve *A*. In initially evacuating the flask the part labeled "flushing piece" is removed and the vacuum connector installed at Point 1. Note all connections except the tapered joints in the flask adapter are ground ball-and-socket joints. Rubber vacuum tubing connects to the vacuum pump but the sampled gas contacts only glass.

When the sampling train is in use it is rigidly mounted on a framework. A low-vapor-pressure, inert vacuum grease is used on all connections and cocks. If the gas stream contains particulate matter it must be filtered to prevent clogging the control valve, and in this case it may be necessary to correct for any error caused by selective adsorption of gaseous components on the solids.

Before sampling, the first steps are to evacuate the flask below 1 mm. Hg abs., using the vacuum connector, then to install the flushing piece and insert the sampling probe through a small hole in the stack. With Valve *A* closed and Valve *B* open the connections should be purged with stack effluent for 2 to 5 min. Then Valve *B* is closed and sampling started by cracking Valve *A*. Sampling rate is held constant by maintaining a constant rate of pressure rise in the flask, as shown by the manometer. By repeated observations of the rate of pressure rise the operator can easily control the opening of Valve *A* to hold a sampling period up to 2 hr.

An intermittent, more approximate method is to open Valve *A* periodically just long enough to give some suitable pressure rise.

From the perfect gas law it can be shown (see authors' more complete description of this sampling method in *AMA Archives of Industrial Health*, 17, No. 6, 654-8, 1958) that the weight rate of sample entrance into the flask is directly proportional to the rate of absolute pressure rise at the manometer; also, that the sampling rate will be constant as long as the rate of pressure rise is constant. Furthermore, Valve *A* is equivalent to two orifices in series so that the critical pressure ratio is about 0.39. This means that in sampling a gas approximating air at 1 atm., flow rate through Valve *A* will hold constant without changing *A* until the pressure in the flask reaches 0.39 atm. Only when the flask pressure rises above this will it be necessary to make periodic adjustments to *A* to hold the flow rate and pressure rise constant.

This method was used satisfactorily in collecting 27 sample flasks at the synthetic rubber plant. Analysis showed that the total gaseous emission from the plant was about 10 tons per day, which checked within 6% the plant's estimates which were based on material balances.

*Present address, Medical Research Div., Esso Research & Engineering Co., Linden, N. J.

NEXT ISSUE: Watch for Announcement of October Winner

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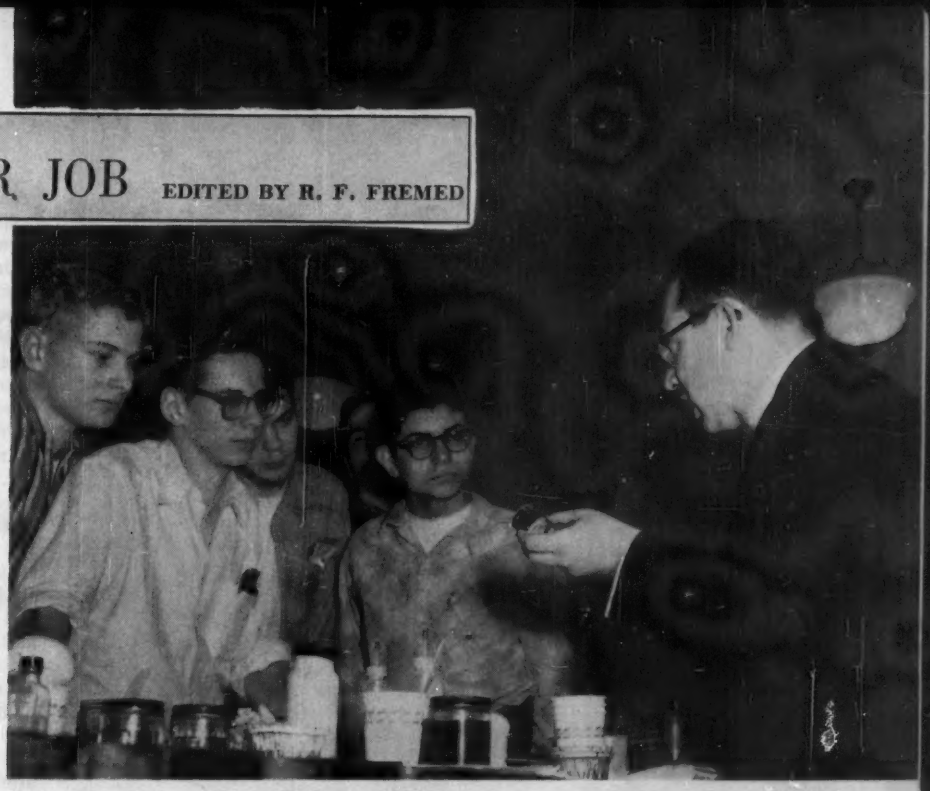


Industry Has a New Role in Education as . . .

Engineers Go Back to High School

WHY should management spend the funds of a private corporation on public education? BECAUSE it increases the supply of top-quality engineers.

Joseph Cryden, Office of Advanced Studies, Hughes Aircraft Co., Culver City, Calif.

Training employees for specific jobs within a company is a long established practice of engineering management. In addition, many progressive corporations provide for their employees education that is related only directly to their work.

However, the concept of spending company funds on the general education of those who are not or may never be employees of the assisting corporation is, to my knowledge, a truly novel one.

Yet, this novel concept is the basis of a rather successful science education program initiated by our company and the Los Angeles school system in 1956, and subsequently expanded to include other companies and other school systems. We call the program the school-industry science program. It now has the active support of a large segment of Southern California industry and Southern California school districts working together as a team.

As engineers, you'll be interested, I think, in this program and how it might be expanded to include your own employer and your own local school district and in what you yourself can do to enrich the science education of your own children and of your neighbor's children.

In this article we'll try to answer these questions:

- Why should management spend the funds of a private corporation on public education?
- What are the aims of a school-industry science program?
- What does the program cost?
- What has this program accomplished so far?

Why Spend Company Funds?

The primary aim of management is profit for the owners of the corporate enterprise. What right, then, has corporation management to expend funds on general science education? How is this expenditure related to increased profits?

The answer lies in modern technology. Now, more than ever, profit is related to the application of scientific knowledge. There is no question that this will be increasingly true in the future. Any expenditure directed at increasing the number—and improving the quality—of scientists, engineers and mathematicians is in the self-interest of a company whose existence depends on the products of research and development efforts.

Projected figures on research and development expenditures and the number of scientists, engineers and mathematicians needed in 1960 and 1965 emphasize this point.

The incentive just described is, of course, long range. It is also general in that all companies benefit and that our share will depend on how many other companies make similar expenditures. However, there are also more immediate returns.

You Get Some Immediate Return

For many corporations, the public relations and advertising aspects of

PROGRAM GOES CROSS-COUNTRY as Max Bart, a Hughes engineer, lectures at New York City's Bronx Science High School.

the program will have great value. Such benefit may not be obvious; but other benefits will be more obvious.

For example, even though we scrupulously refrain from any activity that even remotely resembles recruiting, students who meet company scientists and hear directly of their work are bound to be influenced at the time of job decision. One Steinmetz can make a million for a company whose products are based on research.

Moreover, the very fact that a company engages in this kind of activity will appeal to many first-rate scientists who enjoy educational activity and who will recognize teaching as a rewarding part of their profession.

The chance to participate in a program like the school-industry science program is considered a privilege—a type of fringe benefit—by many engineers and scientists. We also recognize that public goodwill created by this program can mean dollars in unexpected ways to almost any large company.

The incentives are real and strong. The funds expended are properly spent in the stockholder's interest. This is evident in the large number of managements which, after careful consultation with corporation legal staffs, have allocated funds for this program. These include nine companies in the City of Los Angeles alone.

Program Aims Defined

For Hughes, the primary aim of this program is to increase the number of competent scientists and engineers. This does not mean to lure or entice brilliant students into the field with pictures of glamour and promises of rich reward. This would be immoral.

Rather, we recognize that many potentially outstanding or even great scientists are lost to the professions because of inadequacies in lower school science. By helping improve science instruction, our primary aim can be achieved. Good science education will guide and motivate. It will help a student discover his potential for a career in science and will show him the steps to such a career.

We built our program around four specific objectives. These are:

1. What can we do to make the man in the classroom a better teacher?
2. How can we show that classroom work is related to what goes on in industrial science?
3. Can we give the student an understanding of what it's like to be a scientist, of what the daily job is, of what it takes to do the job and of how one prepares for and obtains such a job?
4. Finally, we aim for the gifted student. Can we give him the chance to use his special aptitudes and current knowledge in a typical science or engineering situation?

What We Did

To make the man in the classroom a better science teacher we have been using a summer employment program. Each summer we employ approximately 20 teachers and assign them to science or engineering projects and we have them spend a portion of their time attending lectures and visiting various technical activities.

For the gifted students, we select those of outstanding promise to work on group research projects. Their work has proved to be of considerable value to the community and the companies.

In the classrooms, we established a group of lecture-demonstration teams. Teams were organized in physics, chemistry and mathematics. The procedure was to have each team member organize a lecture-demonstration about his own work. In addition to describing his own work, each lecturer is also asked to talk briefly about his own background and education, referring to specific schools and even courses where this can be worked into the lecture.

Talks are prepared in collaboration with classroom teachers and school science supervisors. Prior to actual presentation, the talks are previewed by several teachers, science supervisors and also by

other team members. Comments and suggestions are directed at relating the talks more closely to course content and at adjusting content to the students' level.

Our lecture-demonstration program is now entering its third year. Forty members of the technical staff at Hughes have prepared lectures. Hughes' scientists and engineers have spoken to almost 2,000 science students. Most of these students have heard eight talks.

We have given our lectures in four schools in the Los Angeles area and in New York City's two top academic science schools — The Bronx High School of Science and Peter Stuyvesant H. S.

Cost and Accomplishment

Is there any evidence that our program has achieved its objectives? We certainly think so.

As a result of our summer employment program, teachers have returned to their classrooms with detailed knowledge of current science applications hitherto unattainable for the high school teacher, except in certain rare instances.

Worth of the summer program for gifted students cannot be judged finally until they have chosen their future careers. In the meantime, we have noted increased enrollments in science and mathematics classes that are in no small measure attributable to this program.

What of the lecture-demonstration team program? Both science teachers and industrial scientists have shown increasing interest in these classroom talks. One technique used in evaluating this program is the questionnaire, checked but unsigned, and with room for free comment. Survey results show that 93% of the students gave the program an over-all rating of "B" or higher and 94% stated that the talks had increased their interest in science. 46% of the students indicated that the program had helped in career planning.

It now remains to consider the cost of the school-industry science program. The salary cost was for summer employment of 22 teachers and 12 gifted students. The first year, the teachers were paid their going teaching salary, but in the second year of the program this was changed to a fixed $540/month. The gifted students were paid a salary of $400 for the summer; in addition, each was given a $400 scholarship.

This adds up to approximately $20,000 for salaries to teachers and students for one summer of employment at Hughes.

Hughes employees spent approximately 1.75 man-years on the program in the course of a single year. Each lecturer in giving six talks, spent approximately 14 hours. For the five Hughes professional lecture-demonstration teams, this represents two man-months of professional effort.

The four planning committees concerned with the program together used up two man-months of time in the course of a year. Finally, Education Dept. personnel at Hughes spent about 1.5 man-years planning and coordinating the program.

All this adds up to the previously stated total of 1.75 man years. This time, plus the money spent on salaries, plus the overhead, adds up to approximately $70,000 for the year's work.

Was this money well spent? My company is built on the application of scientific knowledge. In spending money to improve science education, we feel that we are doing ourselves —as well as our community—a service.

JOSEPH CRYDEN *is a physicist with the Hughes Aircraft Co. and head of its Technical Information Office. He received his B. A. and Ed. M. degrees from Harvard Univ. He taught high school physics for five years before going to work for the Navy as a physicist. While at the Bureau of Ships, he was responsible for developing nuclear radiation devices and supervised the testing of such devices during nuclear explosions.*

EJC REQUESTS

. . . *Ban on Technology*

Of major concern to the Public Relations Committee of Engineers Joint Council are continued references in the press, on radio and TV, in advertising and statements out of Washington, carrying the phrase "science and technology" rather than the more accurate designation "science and engineering."

EJC is now urging its members to help rectify this by calling attention, wherever possible, to the preferred phrase "engineering and science."

CIVIL SERVICE

. . . *Ups the Ante*

New pay laws for federal civil service allow professionally trained college graduates to be hired into jobs at grade level GS-7 instead of GS-5.

Salary range for this grade is $4,980-5,880/yr., with appointments for "top-quality candidates" possible at $5,430/yr. Civil Service Commission is now developing regulations to define top-quality candidates based on their superior college records.

Meanwhile, Congress has authorized the new Space Agency to set up super civil service grades in order to attract key personnel. Salaries for a limited number of scientific, engineering and administrative positions will be allowed to go as high as $19,000/yr.

STARTING SALARIES

. . . *Match All-Time High*

Illinois Institute of Technology reports that starting salaries for 1958 engineering graduates matched 1957's all-time high. Average starting pay for January and June grads was $470/month.

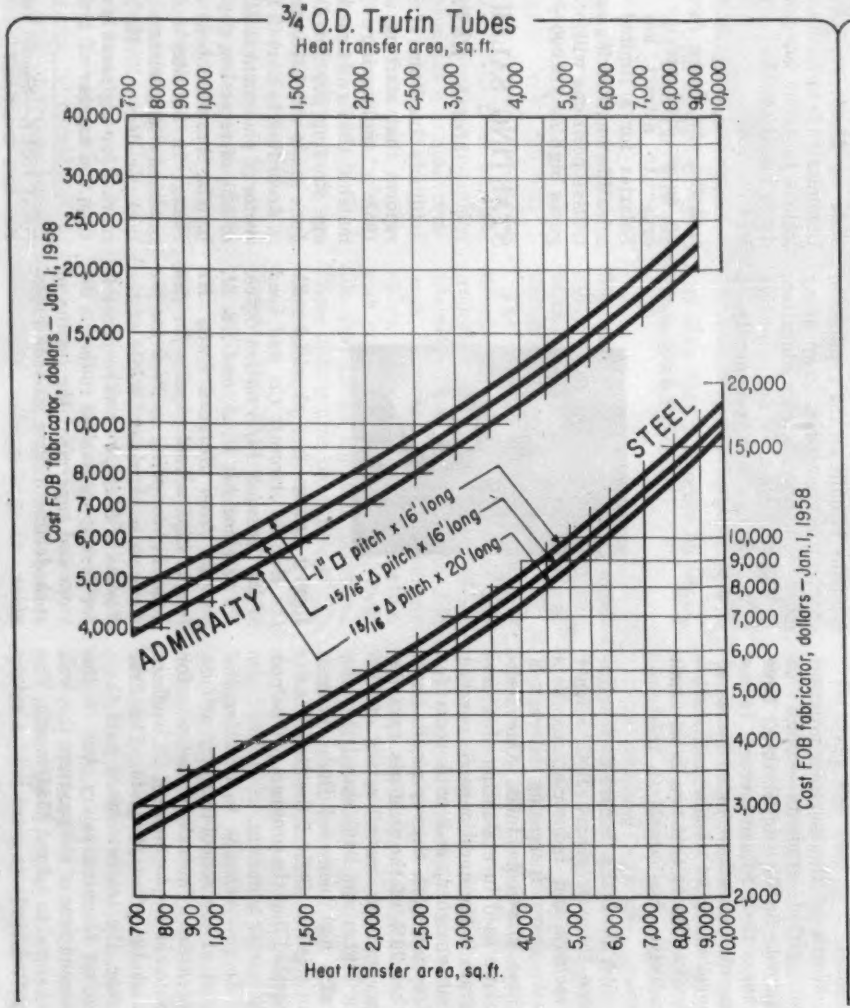
According to Earl C. Kubicek, director of placement at IIT, "In spite of talk of recession, depression and layoffs, there has been no material change in industry's demand for qualified engineers holding a bachelor degree." He added, "the market for engineers is still greater than the number of graduates."

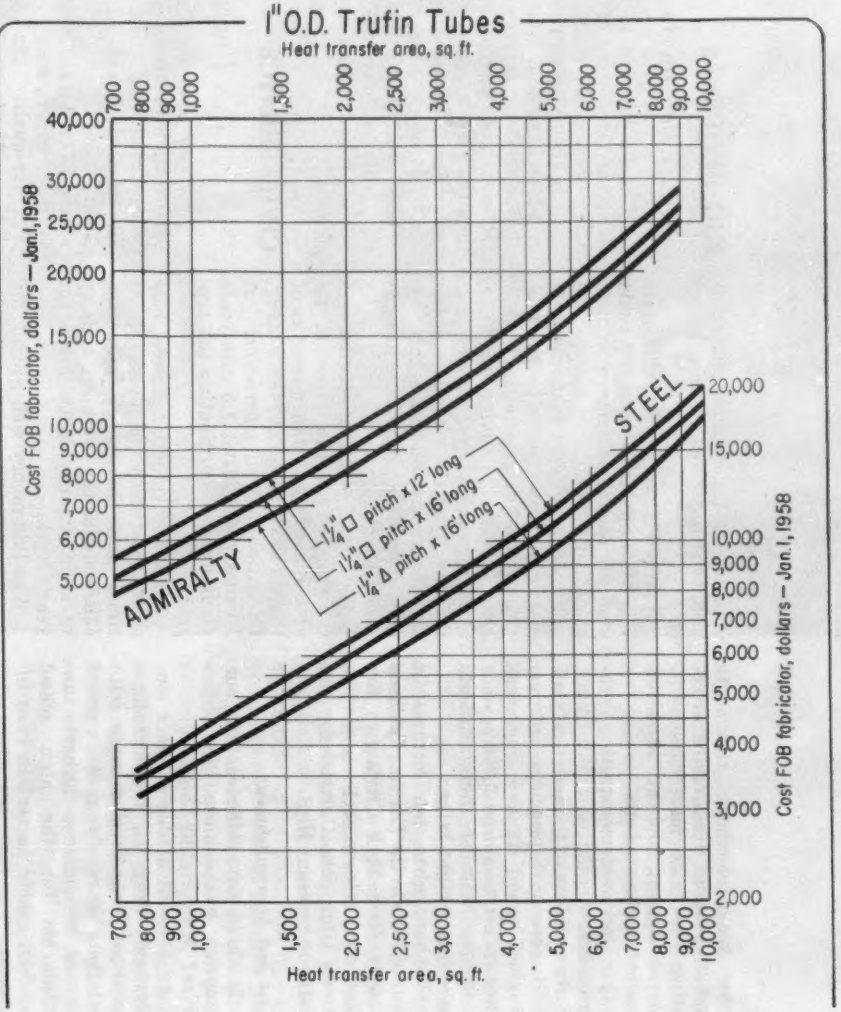
NEXT ISSUE—Should Your Employer Pay You Overtime?

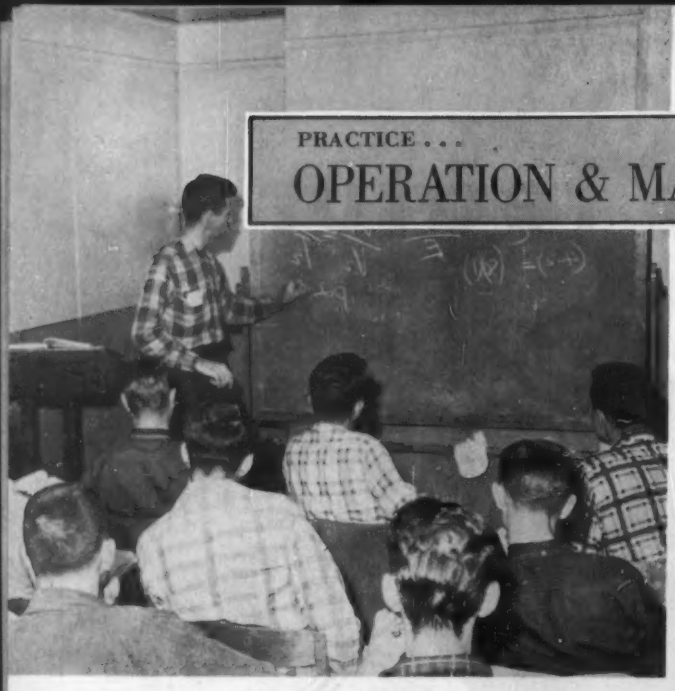
CE COST FILE

NO. 6: Finned Tube Floating Head Exchangers, 150 psi.

H. J. De Lamater; Chairman, AACE Heat Exchanger Cost Committee







THEORY in classroom sessions builds up the trainees' background while on-the-job training helps him gain the necessary PRACTICE.

Train Your Own Instrument Men

J. E. BIGHAM, Instrument Supt., J. A. KUNTZE, Instrument Maintenance Supv., Chemstrand Corp., Pensacola, Fla.

In June of 1953, six months before scheduled operations in our plant were to begin, we realized an urgent need for trained instrument men. This presented a problem that needed solving immediately.

Very early in the game we made our decision—we'll train our own instrument mechanics. Twenty people were hired as trainees. Criteria for selection were rigorous. We used age, intellectual background and interest as the selecting factors.

These 20 people went through a rigid training program. For the first few weeks of their careers, they had eight-hour lecture courses. This tapered off to a more "leisurely" program of morning lecture classes and afternoon shop sessions.

In October 1953, 20 additional trainees were hired and they were given training identical with the June group. Instructors for both of these groups were instrument department personnel: the instrument superintendent, supervisor, engineers and foremen.

These trainees were farm boys, grocery clerks, automobile salesmen, etc. Today, three of them are good instrument foremen in our department. The rest of these men are top-rated instrument mechanics.

Here then is our story. How we set up a program to train our own instrument mechanics at Chemstrand, what this program consists of, and how you can benefit from our experience.

What Are the Requirements?

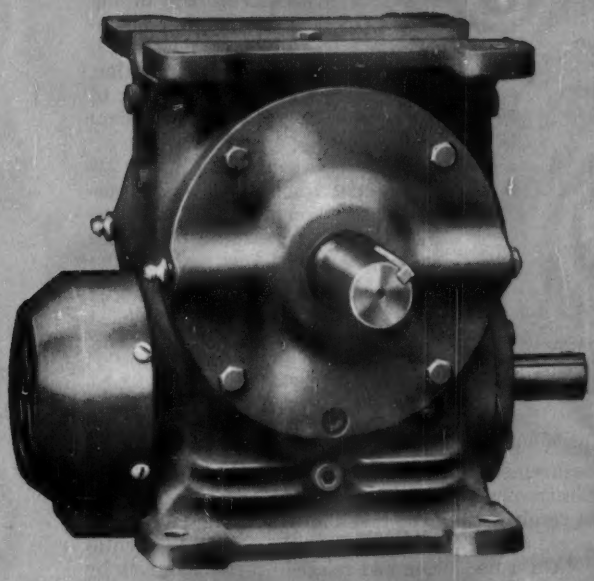
To train someone for a job, they must have the faculties to work with. Let's look at some of the requirements and criteria we've set up to handle this.

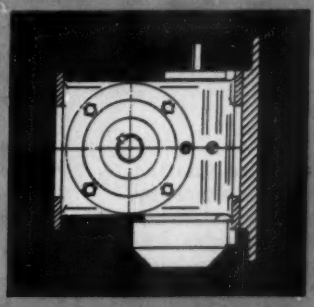
- Age—Prospective instrument trainees should be between 18 and 30 years old.
- Intellectual Background — This is usually determined with a test given by the personnel or employment department. Our organization uses the "Wonderlic Personnel Test of General Intelligence" and the "Detroit Test of Mechanical Aptitude."
- Interest—To check the prospective trainee's interest in instru-

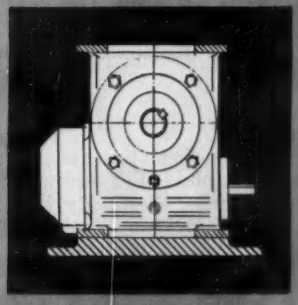
DE LAVAL

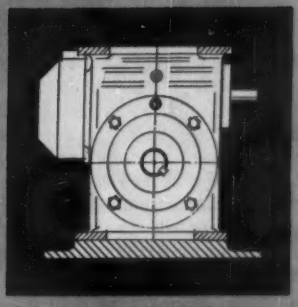
VERSO WORM GEAR SPEED REDUCERS

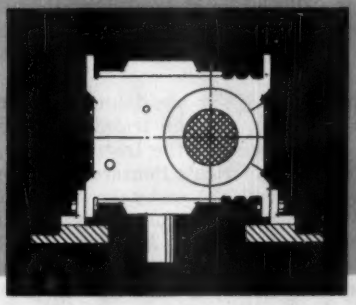
adapt to any mounting requirement

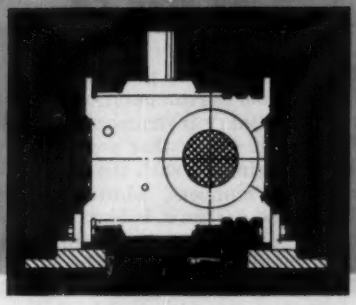


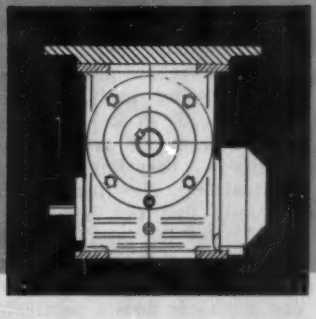












More Horsepower per Dollar

- *Fan cooled*
- *Involute helicoid thread form has heaviest load capacity of any type of worm gear*
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- *Gear shafts are heat treated alloy steel*
- *Worm and worm shaft is a single piece of nickel alloy steel*
- *Gear is made from centrifugally cast bronze*
- *Finest American craftsmanship*

Now De Laval offers you a complete new line of versatile worm gear speed reducers. These reducers are designed for heavy duty industrial work and continuous running under demanding service. The units may be mounted in any position.

For further information write for Bulletin 5018

DE LAVAL *Steam Turbine Company*

803 *Nottingham Way, Trenton 2, New Jersey*

443

ment work, we first have each man interviewed by the employment office and then successively by the engineering department, the instrument maintenance supervisor and the instrument superintendent. By compiling these four interviews, it isn't too difficult to determine the interest a person has in instruments.

Orientation and Safety

Once a man is accepted into the instrument department, either by new hire or inter-departmental transfer, his training begins immediately. It's true, this training is rather slow at the start but it gains in intensity as time goes on.

For the first few weeks of his career, we place the new man in the main instrument shop under the shop foreman's supervision. During this period he's introduced to departmental safety, departmental procedures, various tools of the trade and a brief run-down on types of instruments used in the plant. At this point, the trainee is assigned to an experienced mechanic.

Area Rotation: Major Factor

Assignment of the new man to the field under the guiding hand of an experienced mechanic is done on a rotating basis. Every four months (16 weeks) the man is shifted from one area to another.

This is a very important part of the training. New instrument men not only find out how the plant is laid out but also the different types of installations and applications. In addition, they learn how one mechanic does a particular job in comparison with another and the various difficulties peculiar to any one process.

Very early in the game, they're exposed to just what is expected of an instrument man in the eyes of the instrument foreman and the various operating people.

Besides rotation, after the trainee has been in the department for three to six months, he's placed in a scheduled training class and attends lecture sessions twice a week, three hours a day, until the course is covered.

Training Class is Complete

Content of the training class is contained in three volumes: "Basic Mathematics and Physics," "Principles of Physical Measurement" and "Electricity and Electronics." Each instrument trainee receives a copy of the training volume at the beginning of the class. On completing the training course, all three volumes become his personal property for future reference.

Training Class in a Nutshell

Mathematics and Physics

- Basic mathematics
- Instrument physics

Principles of Physical Measurement

- Hydrostatics
- Hydraulics
- Pressure and temperature
- Pressure measurements
- Temperature measurements
- Level measurements
- Pressure flow meters
- Fluid metering
- Rotameters

Electricity and Electronics

- Fundamentals of electricty
- Solution of D.C. circuits
- D.C. instruments
- Alternating current
- Fundamentals of electronics

Subjects covered under basic mathematics prepare the trainee to make the computations necessary in ordinary instrument work. Experience shows that a complete review, beginning with the basic principles of numbers, addition, subtraction and decimals, is best. It gives us an opportunity to explain the application of these mathematical techniques to the trainee and helps him increase his speed in the manipulation of numbers.

Studying the other chapters in mathematics, we emphasize application to instrument work. All trainees are urged to further their mathematics to better understand trade literature.

In the physics class, special attention insures a knowledge of the computations necessary to understand physics. We go to great lengths to prevent memorizing laws and to encourage reasoning in their thinking.

We concentrate on subjects, such as: acceleration, gravitational forces, momentum, resolution of forces, kinetic and potential energy, moments, center of gravity and states of equilibrium, mechanical advantage and machine efficiency.

Special emphasis is placed on items relating directly to instrument problems, such as: stress, strain, density, transmission of pressure in fluids, applications of the law of flotation, specific gravity, effects of molecular forces in liquids, fluid flow, heat vs. temperature, methods of heat transfer, vapor pressure, fractional distillation, humidity, and the applications of the laws of physics to basic plant equipment and processes.

We remain consistent in our approach to sessions on physical measurement and on electricity and electronics. Along with teaching the basic principles, the mathematics for problem solving and the theories involved, we correlate the subject material with actual maintenance problems and applications to processes and equipment.

Advanced Work Is Encouraged

Our mechanics continue to demonstrate a desire to learn. Many have taken, or are taking, advanced work: electronics, instrumentation and related courses as given by correspondence or attendance of classes at local educational institutions. Chemstrand assists these men through its educational aid policy.

We've also found that our personnel use the training programs offered by the Instrument Society of America's Pensacola Section.

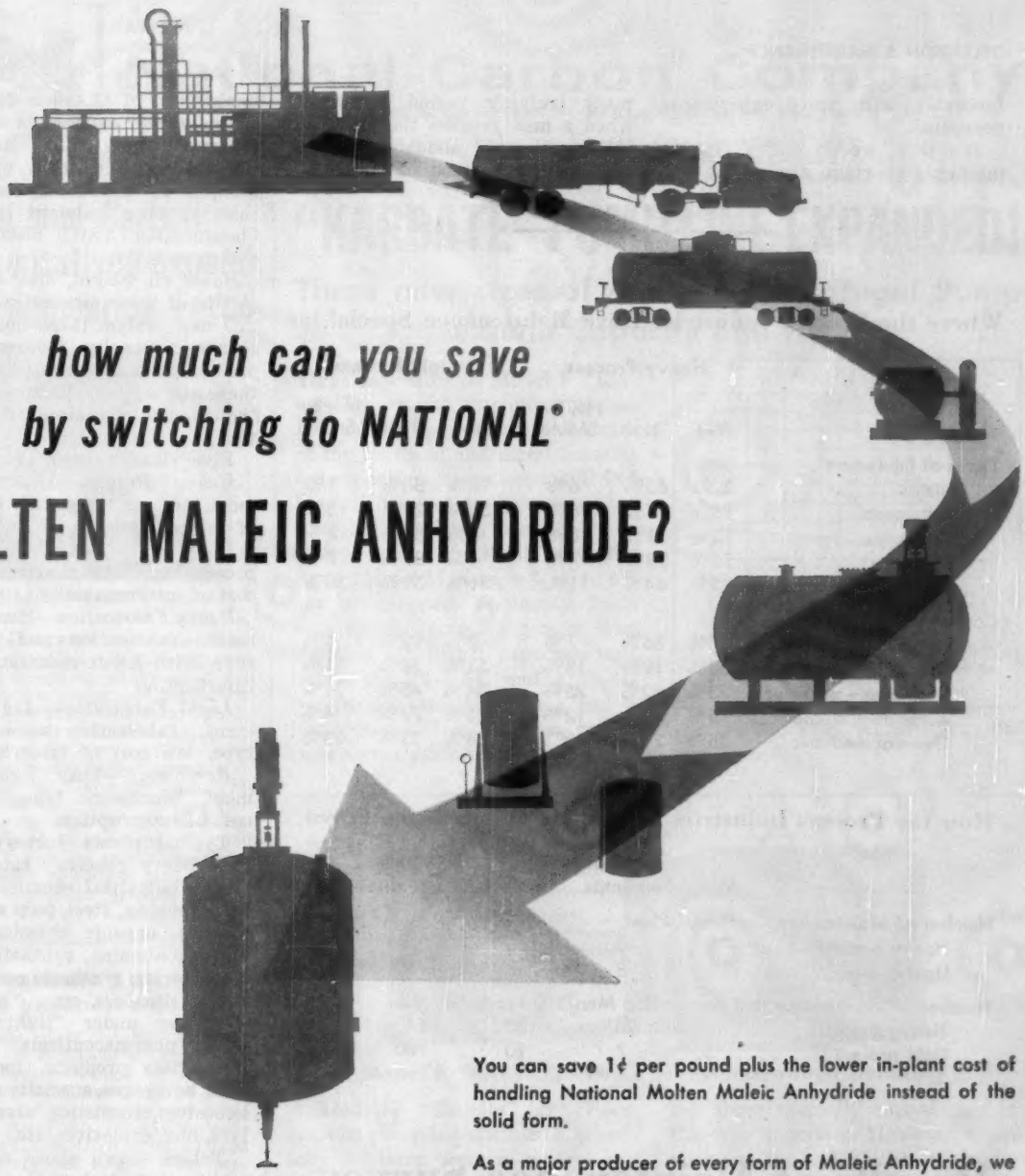
In the past year we've held special training classes for our first-class mechanics. Approximately 120 total hours, representing 3,000 man-hours, of training was given.

Helped by manufacturer's technical personnel, we conducted sessions on maintenance, installation and application of various control valves, basic process instrument loop components and other related subjects of pneumatic, electric and/or electro-pneumatic operating principles.

Program Is a Success

The caliber of our mechanics justifies, without further qualification, our calling the training program a success.

We run with more than 99% of our instruments in continuous operation and "out" time is at an enviable minimum. Our men, relatively new to the field, compare



how much can you save by switching to NATIONAL®

MOLTEN MALEIC ANHYDRIDE?

You can save 1¢ per pound plus the lower in-plant cost of handling National Molten Maleic Anhydride instead of the solid form.

As a major producer of every form of Maleic Anhydride, we have an unequalled background in its most economic use. We'll be glad to figure the net cost of solid vs liquid at your volume level and location so that you can decide for yourself.

Whichever form of National Maleic Anhydride you choose, you'll be getting a uniform, high-purity product made by our exclusive, direct, continuous catalytic-oxidation process. And you'll get excellent service by rail, truck or inland-waterway from our well-located plants at Moundsville, West Virginia and Buffalo, New York.

Why not discuss your possible use of National Molten Maleic Anhydride with us? Meanwhile, be sure to ask for our 12-page Technical Booklet C-2 on your company letterhead. This booklet will help you estimate the approximate potential savings you may be able to realize.

Allied Chemical

NATIONAL ANILINE DIVISION

40 Rector Street, New York 6, N. Y.

Atlanta Boston Charlotte Chattanooga Chicago Greensboro
Los Angeles Philadelphia Portland, Ore. Providence San Francisco

favorably with more experienced personnel.

It's true, we do suffer from a mechanic shortage during the primary training period. However, when a man reaches the mechanic classification, he shoulders his responsibilities immediately.

Where the Process Industries Have Maintenance Specialties

	Heavy Process			Light Process		
	Yes	No	No, But Should	Yes	No	No, But Should
Types of Equipment						
Pumps	29%	65%	6%	13%	86%	1%
Instruments	88%	4%	8%	56%	29%	15%
Hydraulics	13%	81%	6%	4%	89%	7%
Pneumatics	15%	78%	7%	4%	89%	7%
Electronics	45%	44%	11%	31%	39%	30%
Combination Craftsmen						
Electrician—hydraulic	7%	86%	7%	3%	92%	5%
Electrician—millwright	58%	19%	13%	51%	38%	11%
Electrician—mechanic	23%	52%	25%	34%	45%	21%
Automation mechanic	5%	83%	12%	15%	77%	8%
General mechanic	36%	24%	40%	54%	23%	23%

How the Process Industries Size Their Maintenance Force

	Min.	10th Percentile	Median	90th Percentile	Max.
Number of Maintenance Craftsmen/Plant					
Heavy process	12	40	166	576	2,437
Light process	3	8	37	169	460
Number of Maintenance and Engineering Men/100 Production Men					
Heavy process	10	20	50	140	220
Light process	5	7	20	40	50

Results of Maintenance Survey

The how, what, where and why of management practices in industrial maintenance is covered in a new survey by Factory magazine.

". . . The finest maintenance job. You'll find it in heavy process plants. Others please copy." So went a recently published survey of maintenance practices in industry (*Factory Man. and Maint.*, Sept. 1958, p. 90).

Backing up their sweeping statement with 17 pages of data and tables, the article outlines just where industry stands today in maintenance management.

A total of 359 plants responded to their query. Of these, 59 answering the survey represented heavy process industries with a total employment of 81,000. Light process industries accounted for an overall employment of 82,400 in 79 plants.

This survey represents a radical departure from traditional plant classification. Classically, plants are grouped by products. That's the basis of the "Standard Industrial Classification" (SIC) used by federal agencies.

Based on weight, size and complexity of the equipment in a plant, this new system takes note of the economic penalty incurred when production is interrupted. Reason: these are the very factors affecting the extent of a maintenance operation.

Five classifications set up are:

Heavy Process—Heavy equipment, process type with high cost of interruption.

Light Process—Light equipment, process type, with moderate-to-high cost of interruption.

Heavy Fabrication—Heavy equipment, fabrication-and-assembly type, with low-to-moderate cost of interruption.

Light Fabrication—Light equipment, fabrication-and-assembly type, low cost of interruption.

Benchwork—Very light equipment, benchwork type, very low cost of interruption.

Typical plants surveyed under the "heavy process" category include: industrial chemicals, petroleum refining, steel, pulp and paper, plastics, organic chemicals, magnesium, alumina, synthetic rubber, refractories, synthetic resins, naval stores, titanium, etc.

Falling under "light process" were: pharmaceuticals, soap and fats, glass products, food, paint, dyes, beverages, specialty chemicals, adhesives, cosmetics, aluminum alloys, film, explosives, etc.

Tables shown above are typical and are keys to how the process industries size their maintenance force and where this maintenance force is being specialized. These figures aren't necessarily reliable guides to sizing your maintenance force. They just serve as hints to where you stand with industrial maintenance practice in general.

For a detailed analysis you'll have to check the original survey. Coverage there, is given not only to sizing and complexity but also how industry controls maintenance costs, how maintenance employees are handled (unions, salaries, etc.), what techniques are used to solve maintenance headaches and where plant facilities are being updated.

News from

National Carbon Company

Division of Union Carbide Corporation · 30 East 42nd Street, New York 17, N. Y.

Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco. IN CANADA: Union Carbide Canada Limited, Toronto

National Carbon representatives expand your Engineering Force

S. J. MILLER—SALES ENGINEER

After graduation from Massachusetts Institute of Technology with a BS degree in Chemical Engineering, Miller spent five years in process design and production supervision, including equipment specifications, economic evaluations of processes, and plant start-ups.

Miller has been a Sales Engineer with National Carbon Company since 1953. Knowing chemical plant corrosion problems from actual experience, Steve Miller is well equipped to assist engineers and plant operators on the application, design and installation of carbon, graphite and "Karbate" impervious graphite process equipment.

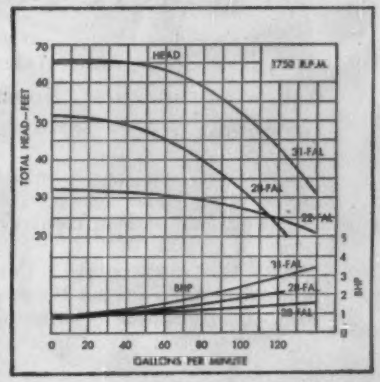
New Activated Carbon finds extensive use!

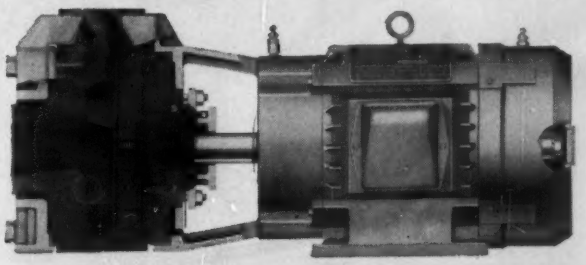
A new grade of "Columbia" activated carbon for use as a catalyst support material has been developed by National Carbon Company. Combining high activity, strength and porosity, the new grade CXC 4/6 is priced at half that of the well-known grade CXAL 4/6 it replaces. Grade CXC 4/6 is expected to give better performance than previous grades in a wide variety of additional uses. It is available in the form of 3/16" diameter pellets. For details, write National Carbon Company.

"KARBATE" PUMP LINE EXPANDED!

Three new sizes of Model F Centrifugal Pump extend Capacity and Head

Three new sizes of Model F "Karbate" impervious graphite pumps are now available to meet the demands of the chemical and metal finishing industries for greater capacities and heads. These are designated as Sizes 22-FAL, 28-FAL, and 31-FAL. Operating at 1750 RPM, capacities up to 150 GPM and heads up to 67' can be obtained. To handle fluids with specific gravities greater than water at the higher capacities and heads, the 28-FAL and 31-FAL pumps are available with 3 and 5 horsepower motors. The chart on the right shows performance curves for the new Model F "Karbate" centrifugal pumps.





Model F "KARBATE" Pump withstands rough handling

A Model F "Karbate" impervious graphite pump has operated successfully for three years in a large refinery's portable equipment cleaning unit. The "Karbate" impervious graphite parts of the pump withstood the abuse normally encountered in this type of service. However, when changing the seal, the steel support casting was damaged. The body bolts were tightened so hard that the pressure broke the casting. The "Karbate" volute case and cover were not even chipped. Here is proof that "Karbate" impervious graphite pumps are built to "take it" and that the armored design minimizes the possibility of damage even under the most severe operating and poorest maintenance conditions.

Porous Carbon Filter Tubes available from National Carbon Company

National Carbon Company can produce and supply all styles of porous carbon filter tubes for tube type filtering equipment. Tubes having any I.D. and O.D.'s up to 6⅝" with lengths up to 36" can be manufactured from available stock. In addition, Grade 40 porous carbon filter tubes, Style B, 2⅛" I.D. x 4½" O.D. x 36" long are in stock for immediate delivery. Sizes and prices of porous carbon filter tubes will be supplied upon request.

STYLE A STYLE B STYLE C STYLE D

NATIONAL TRADE MARK

PRACTICE . . .

CORROSION FORUM

EDITED BY R. B. NORDEN

For Nuclear Reactors:

Zr Is More Popular Than Ever

New economic data, unique properties, boost zirconium to top position.

Zirconium and its alloys are becoming more and more popular as nuclear materials of construction.

Why this high regard? Certainly first costs are not the reason. Reactor-grade (hafnium-free) sponge runs between $4.54 and $7.72/lb; commercial-grade sponge is quoted at $7.50/lb; zirconium tubing at $40 and $60/lb.

Of course, corrosion resistance is part of the story: The corrosion rate of aluminum in 500 F. water is several hundred times that of zirconium. And Zr alloys are very resistant to attack by oxygen-free sodium up to about 930 F.

Small amounts of some impurities (nitrogen, aluminum, titanium) decrease the corrosion resistance of pure zirconium. For this reason, alloys such as Zircaloy-2 (1.2 to 1.7% tin; 0.07 to 0.2% iron; 0.05 to 0.15% chromium; 0.03 to 0.06% nickel) and Zircaloy-3 (0.25% tin, 0.25% iron) have been developed. These alloys have a considerable tolerance for impurities.

▶ **High Strength** — But zirconium has other properties, many of them unique, which help keep this material up front in the nuclear field.

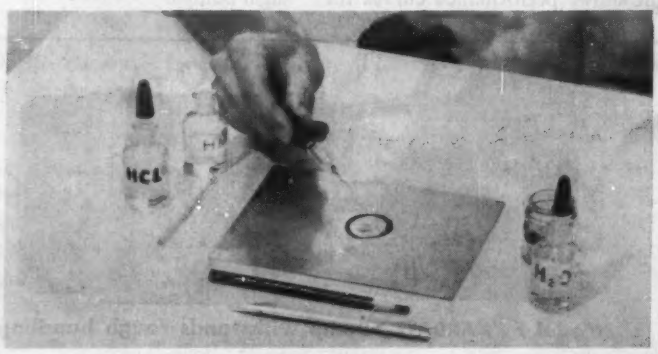
As a structural material zirconium holds its strength at high temperatures (see table). Zircaloy-2 as annealed, has a yield strength of about 16,200 psi. at 800 F., while aluminum's yield strength is 1,500 psi. at 600 F. (commercially pure aluminum).

▶ **Resists Irradiation**—Also, zirconium has the ability to resist changes in properites as a result of neutron irradiation.

Irradiation causes an increase in the yield strength of zirconium at a somewhat faster rate than the ultimate strength. This means a progressive decrease of toughness and ductility. However, zirconium retains appreciable ductility and toughness after cumulative exposures as high as 5×10^{21} neutron/cm^2, an exposure corresponding to about 2 years in a flux of 10^{14} neutrons/(cm^2) (sec).

And zirconium is not difficult to fabricate. It's reactive, so welding must be done in an inert atmosphere. But forming and machining techniques are routine now.

Since uranium in some form or other is the most common fuel for current and probably future reactors, zirconium owes part of its popularity in reactors to the fact that it is compatible with uranium and uranium compounds (it is also compatible with thorium). Zirconium can be alloyed with uranium to improve the properties of the fuel or to serve as a diluent.



Easy Test Spots Different Stainless Types

A new chemical test easily shows up the difference between Type 200 and Type 300 stainless steels (200 is the high-manganese, low-nickel stainless).

Developed by Electro Metallurgical Co., the test calls for HCl, sp. gr. of 1.19 (regular conc. HCl); nitric acid, sp. gr. 1.42 (regular conc. HNO_3); sodium bismuthate and water.

All you do is place two drops of nitric acid, followed by one drop of hydrochloric on the metal specimen. After the reaction subsides, add two drops of water and mix with a glass stirring rod. Then add a pinch of sodium bismuthate, mix with the rod. If all sodium bismuthate dissolves add small portions until there is an excess of this reagent. After thirty seconds to a minute, 200 will give a dark reddish-brown spot, 300 will give a tan spot.

It's a good idea to familiarize yourself with the test on a known specimen. Also, on sheet material, a ¼-¼-in. dia. dimple made with a blunt nose punch or a 1-in. circle made with a grease pencil will confine the spot test area.

Metal chlorides causing corrosion?

...Test **HAYNES** Alloys

In recent tests, HASTELLOY alloy C resisted corrosive ferric chloride solutions so thoroughly that no weight loss could be measured over a five-day period. Similar results were obtained with cupric chloride. Other tests proved that alloy C is virtually immune to corrosion from sea water. HASTELLOY alloy B, another HAYNES alloy, offers outstanding resistance under reducing conditions to solutions of magnesium and aluminum chlorides.

What effect do contaminants, temperature, flow rates, and concentration have on this resistance? Why not find out for sure by testing HAYNES alloys under your own process conditions? We'll gladly send you samples. To help us select the alloy most likely to solve your problem, we suggest that you send us a letter outlining the corrosive conditions in your plant. To learn more about HASTELLOY alloys, ask for a copy of our 104-page book.

HAYNES
ALLOYS
HAYNES STELLITE COMPANY
Division of Union Carbide Corporation
Kokomo, Indiana

UNION CARBIDE

The terms "Haynes," "Hastelloy," and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

Important Tensile Properties of Annealed Zirconium

	Yield Strength, Psi., 0.2% Offset	Tensile Strength, Psi.	Elongation, %
Zirconium			
80 F.	31,700–32,700	54,500–54,750	42–38
797 F.	7,500	14,500	59.1
932 F.	5,200	11,200	88.5
Zircaloy-2			
80 F.	41,000–43,000	54,600–54,800	32.0–28.7
797 F.	16,200	20,000	37.4
932 F.	13,800	19,500	42.1

▶**Where It's Used**—The Experimental Boiling Water Reactor (EBWR) at Argonne National Laboratory employs a fuel alloy composed of uranium, zirconium (5%) and columbium (1.5%). In this case, the zirconium helps to improve irradiation stability of the fuel. Fuel is clad with Zircaloy-2.

The pressurized-water reactor (PWR) at Shippingport, Pa., employs a fuel alloy in one section of the core which contains between 90 and 95% zirconium.

In addition to being a useful material for water reactors, zirconium is also useful in other types. The sodium-graphite reactor at Santa Susana, Calif., uses zirconium as a low-neutron absorbing barrier between the liquid sodium and the graphite blocks. The Power Reactor Development Co. plans to use zirconium as a cladding material for fuel elements in its fast power breeder reactor at Lagonna Beach, Mich.

Also, there are the heavy-water-cooled, heavy-water-moderated, natural-uranium power reactors, which will require zirconium alloys for cladding and perhaps pressure tubes.

Depending upon size and type, reactors require from 5,000 to 50,000 lb. of sponge zirconium each. For those reactors requiring the larger amounts of zirconium, capital charges for zirconium will account for an appreciable fraction of the cost of the electricity produced. A further drop in the cost of zirconium, which appears likely, would thus represent a significant step toward economic nuclear power.

A recent study by Mason Benedict, of MIT, discussed the economic comparison of zirconium alloys and stainless steel in nuclear power reactors. This study indicated that zirconium alloys can be used economically for permanent parts of commercial power-producing reactors when fueled with uranium enriched up to at least 4% uranium-235. It shows that zirconium alloys should be used to clad natural uranium-type fuel elements, and that, at current mill-product prices, Zircaloy is definitely competitive with stainless steel for fuel cladding in slightly enriched reactors. Here zirconium can be substituted on approximately a volume for volume basis.

▶**Some Disadvantages** — While it has many advantages, zirconium does have some undesirable characteristics.

The reactivity of zirconium limits the re-use of scrap produced in fabrication operations. Heavy scrap can be cleaned and remelted, but fine scrap, such as turnings, is excessively contaminated. Therefore, such scrap must be completely recycled by burning to the oxide, converting to the tetrachloride, and then reducing to sponge. Fine scrap such as machine turnings, must be handled carefully to allow a minimum exposure to air and moisture. Several serious fires and occasional explosions have been reported due to improper scrap handling.

A recent report from Argonne National Laboratory, in connection with the manufacture of zirconium-clad fuel elements for the Experimental Boiling Water Reactor, states that 46% of the zirconium received in the form of 1,000 lb. ingots was accounted for in the finished product, and only half of the scrap was of a type suitable for direct recovery.

▶**Breakaway Corrosion** — Also zirconium and its alloys have one undesirable corrosion characteristic. After a considerable period of time, the corrosion film loses some of its protective qualities and more rapid corrosion, called "breakaway" corrosion, occurs.

For unalloyed zirconium in 680 F. water, breakaway begins after about 250 days. Breakaway would not be expected until after very long exposure (thousands of hours) at test temperatures of 600 F or lower. Post-breakaway corrosion rates for unalloyed zirconium are excessively high—on the order of 100 milligram per square decimeter per month. Zircaloy-2, although it has a pre-breakaway corrosion rate slightly greater than that of high-purity zirconium at its best, has a post-breakaway rate much less than that of zirconium—on the order of 7 mg/(dm^2) (month).

But the future of zirconium in the nuclear field seems secure. There are now four sponge producers: Mallory-Sharon, Columbia-National, Carborundum Metals, and Wah Chang. Total available capacity for sponge zirconium is about 6-million lb./yr.

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(*Continued*)

New Coating Turns Mild Steel Into Stainless

A new coating gives mild steel the corrosion and oxidation resistance of stainless and other high-alloys. At least this is the claim Wall Colmonoy (Detroit, Mich.) makes for their recently developed Nicrocoat alloy technique.

A leading feature of the process: it's readily applicable to thin sections (formed members, sheet metal parts, and other non-machined sections). Protection can be applied to either the entire assembly or to a selected critical area. Also it's claimed Nicrocoat will prevent oxidation of readily oxidizable materials such as molybdenum and columbium (niobium).

Technique involves applying a very thin coat of a special alloy to the base metal, following fabrication.

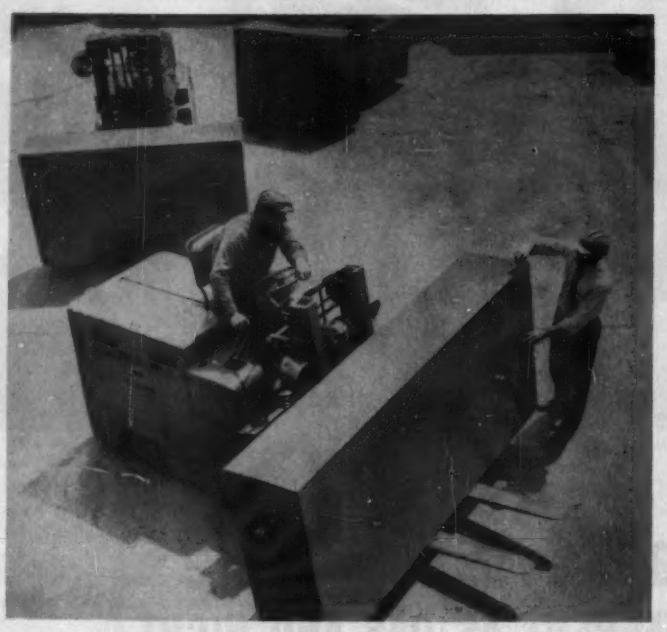
The alloy is then bonded to the base metal by heating to a specified temperature under controlled conditions in a pure dry-hydrogen-atmosphere furnace.

The Nicrocoat alloy is furnished as a powder for mixing with Nicrobraz cement. When mixed to the desired consistency, it may be applied by cold-spraying, dipping or brushing.

Thickness of the applied coat may vary from 0.002 to 0.010 in., depending upon the thickness of base metal, design of the part, and service requirements. The thin overlay precludes finish grinding—coating is used in the as-bonded condition.

Three alloys are available for use with the Nicrocoat process. Designated Nicrocoat Nos. 1, 2 and 3, the alloys have a common high-nickel base, but each is intended to meet specific service requirements.

Nicrocoat No. 1 is best for maximum oxidation, abrasion and corrosion resistance. Recommended bonding temperature is 2,150 F. Nicrocoat No. 2 is intended for use in applications where the bonding temperature must not exceed 1,950 F. Nicrocoat No. 3 is to be used with extremely thin base metal sections, 0.015 in. or less thick. With the No. 3 alloy, coating thickness is limited to 0.002 to 0.005 in.; bonding temperature is 1,800 F.



Giant Graphite Blocks Speed Honeycomb Production

The large graphite blocks above will permit fabrication of honeycomb panel sizes previously impossible to produce.

Most missile and aircraft designers are turning to stainless steel honeycomb panels for maximum strength with minimum weight. In making these sections, stainless-steel skin surfaces are joined to honeycomb cores in high-temperature brazing furnaces. Graphite is used to support the panels, but until now, the size of graphite blocks limited the size of the panels.

However, National Carbon has developed new production techniques which permit manufacture of 110-in. long, 20 in. wide and 46½-in. high graphite blocks. Previous blocks were 62-in. long.

A big factor behind this development: single honeycomb panels 10 x 20 ft. are on the drawing boards, and one new chemically-fueled bomber will use 19,000 sq. ft. of honeycomb.

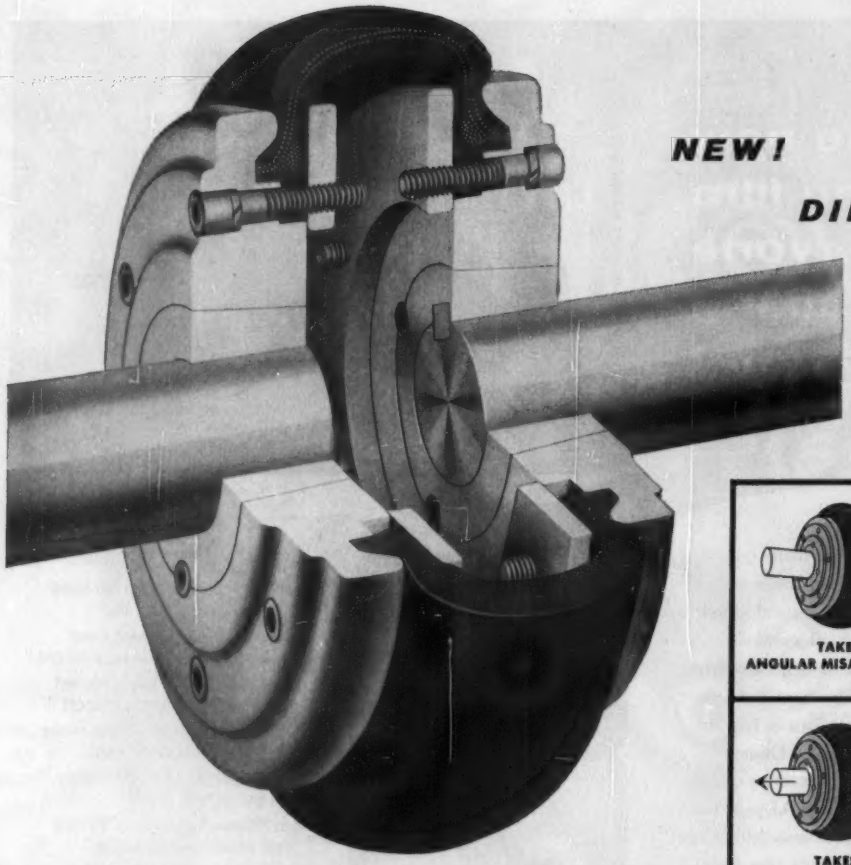
Test Polypropylene Under Your Own Conditions

Interested in testing the new plastic, polypropylene? American Agile offers—without charge—a welding joint made of polypropylene to any prospective user.

The welded section is sent inside a test tube under highly stressed conditions. You then cover the specimen with a corrosive liquid and keep the solution at desired temperatures.

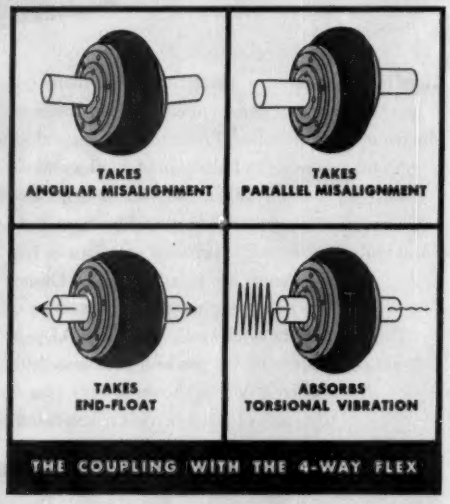
So far, in 4,000 hours of testing in the Agile laboratory, only sulfuric acid has destroyed welded polypropylene fabricated sections. For specimens the address is: American Agile Corp., P. O. Box 168, Bedford, Ohio.

With the ability to stand up to higher temperatures than polyethylene, polypropylene has a future in tank, container and piping applications.



NEW!

DIFFERENT!



DODGE

Para-flex

FLEXIBLE CUSHION COUPLING

THIS coupling "swallows up" shaft misplacements. It automatically compensates for end-float, parallel misalignment, angular misalignment or *any combination of all three.* Moreover, it cushions the stresses of shock loads. And it absorbs torsional vibration—reducing noise and protecting machinery from vibration's destructive forces.

Here is a new type of performance—made possible by the development of a tire-like flexing element. Synthetic tension members, bonded together in rubber, give this element the stamina and dependability of modern, high-speed, high-load, shock-absorbing truck tires—and the ability to respond magically to all manner of changing shaft conditions.

Para-flex takes minimum space on the shaft. Mounting is simplified through the use of standard Taper-Lock bushings—no reboring, no machining. Safety is promoted by flush design; there are no protruding parts. No lubrication is required, no periodic inspection. And since the flexible member is molded with a transverse split, it can be replaced *without moving either the driver or driven machine.*

Para-flex Couplings are stocked by Dodge Distributors in popular transmission sizes. They are available from factory stock in capacities up to 825 hp at 1200 rpm. Call your distributor for early delivery to *make your own test.* You'll witness something revolutionary!

DODGE MANUFACTURING CORPORATION, 200 Union, Mishawaka Ind.

DODGE

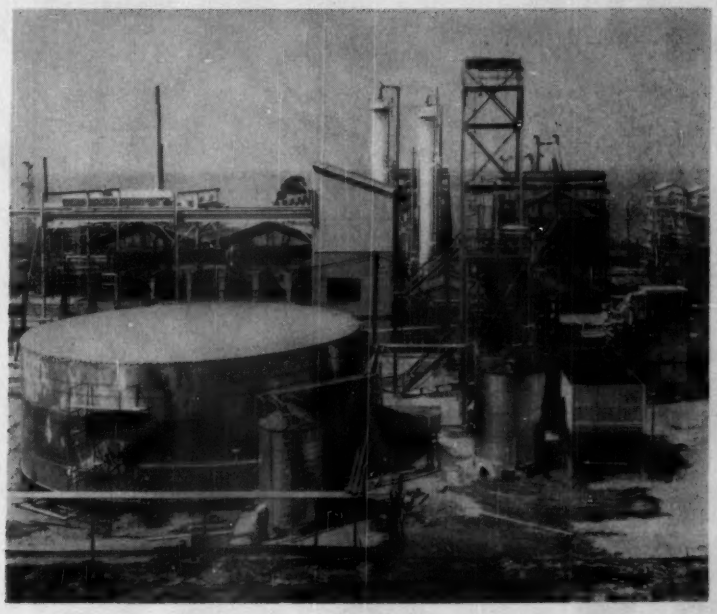
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

FIRMS IN THE NEWS

R. A. LABINE

NEW FACILITIES



New Hercules Urea Plant Uses Inventa Process

Hercules' 20,000 ton/yr. urea plant at Hercules, Calif., is now in commercial production. Unit is built around Inventa-Vulcan urea process; 75% of production will go into high-nitrogen liquid fertilizers, remainder will be used for urea-formaldehyde resins for plywood and particle board industry.

Chippewa Plastics, Inc., has opened a new $500,000 polyethylene film plant at Chippewa Falls, Wis. Plant has two of its three floors underground for efficient materials flow: Raw resin drops from silos into feed hoppers on second level for extrusion machines on lowest level. Extruded film then travels vertically upward to finishing machines on ground floor.

Allied Chemical announces that expansion of caprolactam monomer facilities at Hopewell, Va., is ahead of schedule. New units will go on stream Jan. 1, 1959 and will bring annual monomer capacity "in excess of 60 million lb." (Caprolactam is basic monomer for nylon 6 fibers and molding resins.)

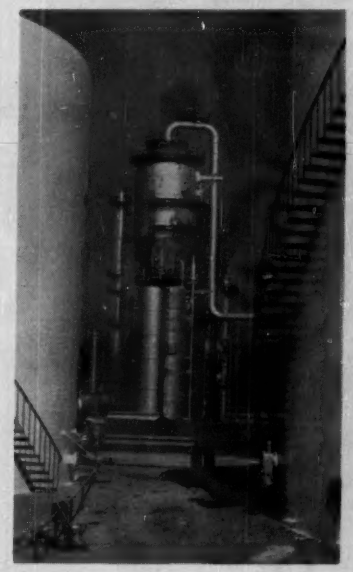
Reichhold Chemicals is starting construction on a $1-million synthetic resins plant in Houston, Tex. Company spokesman says firm is interested in Houston because of the large natural gas reserves and that plant investment may ultimately reach $25 million.

Pennsalt Chemicals has placed a new ammonium chlorate plant on stream at its Portland, Ore., works adjacent to firm's sodium chlorate plant. Ammonium chlorate is used as an oxidizer in solid propellants.

Girdler Construction will design and erect a 3-million-cu.-ft./day hydrogen plant for new St. John, New Brunswick,

FIRMS . .

refinery being built for Irving Refining, Ltd. New Brunswick unit will be the third of its kind designed by Girdler for the petroleum industry.



British American Oil has swung its new $25-million refinery on stream at Port Moody near Vancouver, B. C. Plant, processing 20,000 bbl./day crude oil, is biggest single project ever tackled by company. Above, storage tanks frame catalytic cracking unit.

Texaco has apparently shelved any immediate plans for an oil shale laboratory at Salt Lake City. Firm bought 25 acres in September in heart of Salt Lake refining district and announced intent to erect a shale oil lab on the site. Now, Texaco officials will say only that "Texaco will begin shale oil production whenever processes make shale oil economically competitive with other oil sources, or when need for oil becomes so great that shale oil must be used."

Atomic Energy Commission announces tentative agreement for adding 1,770 tons/day uranium ore capacity to Gas Hills district of Wyoming. Plans call for building two new mills: 522-ton/day mill by Federal Uranium Corp. and a 492-ton/day mill by Un-

FIRMS . . .

ion Carbide Nuclear. Other mills would expand capacity or step up contract sales to AEC.

Hooker has installed "world's largest" silicon power rectifier (12,000 a. at 360 volts d.c.) at its Niagara Falls, N. Y., chlorine-caustic plant. Unit is first of four to be installed in next six months at a cost of $1 million. Move marks plant changeover from 25 cycle to 60 cycle current.

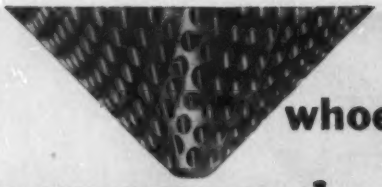
Du Pont will build a polyethylene film laboratory and pilot plant adjacent to Polychemicals Dept.'s principal polyethylene resin facility at Orange, Tex. Company believes that facility will pave the way for commercial film manufacture.

Koppers has landed a contract for 17 Koppers-Becker coke ovens to be installed at Brazilian National Steel Co.'s Volta Rendonda plant. These 17 chemical-recovery units plus three pitch-coking ovens will make up Battery No. 4; Koppers previously erected Batteries 1 and 2 and is now completing No. 3.

Shell Chemical (Australia) will build a $1.5-million plant near Sydney, Australia, to make epoxy resins. Unit is expected to be completed early in 1960 and capacity will be sufficient for entire Australian demand.

Clinton Corn Processing Co., Clinton, Iowa, is installing a new continuous solvent extraction system that will expand corn germ processing capacity to 170 tons/day. Supplied by Blaw-Knox, Rotocel system replaces outmoded corn oil extraction equipment.

U. S. Government is reportedly planning two nuclear power plants for Alaska in addition to the announced reactor at Big Delta. Power plants will be primarily designed to serve military installations. Fuel oil is currently being flown to two Alaskan defense bases at a cost of $0.30/gal. to power

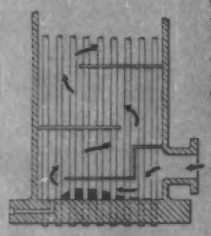


whoever heard of a conical tube sheet?

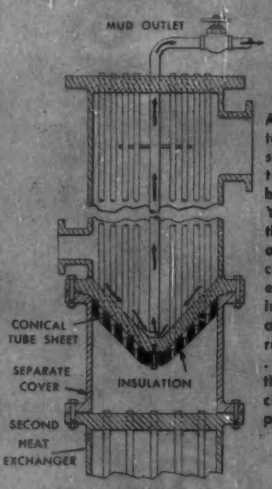
YUBA! and helped solve ARAMCO'S problem

THE PROBLEM

In the original heat exchanger, shown at left, sludge in the cooling water settled on the flat tube sheet, causing corrosion at the tube joints. A stepped baffle to increase water velocity across the tube sheet and a connection to blow away the sludge helped only partially. Within one year some tubes failed because of the sludge-induced corrosion.



ARROW — INDICATES FLOW OF WATER



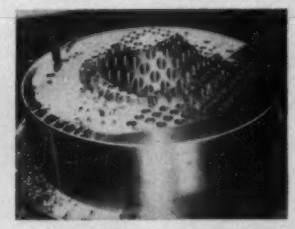
ARROW — INDICATES FLOW OF MUD

THE SOLUTION

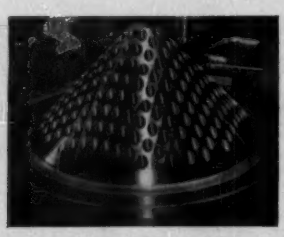
Aramco believed that a conical tube sheet would permit the sludge to settle to the apex of the cone, where it could be blown from the exchanger. Yuba's experience quickly solved the fabrication details. Because of abrasive particles in the fluid coming from the bottom heat exchanger, ferrules were placed in the tubes and erosion-resistant insulation around the ferrules to protect the tube ends . . . the whole job, an illustration of Yuba cooperation with client engineers to reach a practical solution of a problem.

PRODUCING THE CONICAL TUBE SHEET—THE INGENIOUS PART OF THIS YUBA HEAT EXCHANGER

A forged tube sheet conical both inside and out could not have been drilled because there would have been no purchase for the drill. So Yuba started with a forging which was flat outside and conical inside and then drilled holes on the flat outside surface.



The outside conical surface takes shape as unwanted metal is cut away. When the previously drilled holes became shallow, the drill was reinserted and the holes made deeper. Then more metal was cut away. This process was repeated until . . .



. . . the conical tube sheet was finished. The tube sheet was placed in the Yuba heat exchanger, tubes inserted and welded to sheet. Then replaceable ferrules and insulation were used to protect the tube ends from erosion . . . truly an engineered heat exchanger.

YUBA CONSOLIDATED INDUSTRIES, INC.

Heat Exchangers designed and manufactured East and West

YUBA HEAT TRANSFER DIVISION Honesdale, Pa.
ADSCO DIVISION Buffalo, N. Y.
YUBA MANUFACTURING DIVISION Benicia, Calif.

Plants and Sales Offices NATIONWIDE

Towers | Expansion Joints | Pressure Vessels | Structural Steel

YUBA

diesel generators — nuclear power can probably compete favorably at such costs.

Monsanto has started up a second 30,000-kw. electric furnace at its elemental phosphorous plant at Soda Springs, Idaho, resulting from increased demand for phosphorous salts from detergent producers. Furnace had been shut down for six months due to sagging demand.

Escambia Chemical Corp. has dedicated its new 50,000-sq.-ft. research laboratory at Wilton, Conn. Facility will house research projects on pharmaceutical intermediates, chemicals for plastics industry and synthetic organic chemicals.

MERGERS & ACQUISITIONS

Kennecott Copper is planning to acquire the Okonite Co. through an exchange of shares, subject to approval of Okonite stockholders on Nov. 24. Arrangement will bring Kennecott's copper resources into alliance with a leading electrical cable maker.

Stauffer Chemical has acquired a 50% interest in Fluor-Mex., S. A., presently the sole producer of hydrofluoric acid in Mexico. Plant is located at Santa Clara, near Mexico City.

American Meter Co., manufacturer of gas meters and industrial instruments, bought the Buffalo Meter Co., Buffalo, N. Y., for an undisclosed sum. Firm will be operated as an independent subsidiary.

Thompson Products' stockholders have voted to merge the firm with Ramo-Wooldridge Corp., Los Angeles. New corporate name: Thompson Ramo Wooldridge, Inc.

Ciba's plastics division has merged with its manufactur-

FIRMS . . .

ing affiliate, Ciba Products Corp. Kimberton, Pa., present headquarters for Ciba Products, will remain the home office of the new organization.

NEW COMPANIES

Stauffer Chemical and E. Merck AG., Darmstadt, Germany, are jointly launching new pharmaceutical firm known as Stauffer Pharmaceuticals, Inc. New company will initially manufacture bulk quantities of several pharmaceuticals and fine chemicals in the E. Merck line and will market them in the U. S. and Canada.

SunOlin Chemical Co. is being formed as a joint subsidiary of Olin Mathieson and Sun Oil to direct urea activities growing out of new urea plant being built at Sun's Marcus Hook, Pa., refinery.

Vitro Corp. and Koppers Co. announce signing of a joint agreement that will pool resources of Vitro Laboratories and Koppers' Metal Products Div. for work on weapons systems for Defense Dept.

Buffalo Industrial Fabrics is a new company, with headquarters in New York City, supplying industrial fabrics for laminating, filtration, coating and allied applications.

Century Chemical Corp., New York, N. Y., has been organized to enter field of chemical manufacture. Firm says it will have more details of intended manufacturing operations "around the first of the year."

Montecatini, Italian chemical giant, and Stickstoffewerke AG., Austrian chemical maker, have signed a joint agreement to manufacture polypropylene in Austria—initial production of 11 million lb./yr. is planned.

They compared "K" factors and cost factors . . . and bought SNAP*ON®

FOR FREE TEVA SURVEY CALL YOUR LOCAL G-B SNAP*ON DISTRIBUTOR LISTED IN ADJOINING COLUMN

For big pipe applications, they found nothing that can actually *be* compared with Snap*On, the original one-piece pipe insulation molded of fine glass fibers. *Only* Snap*On is offered in one-piece sections, plain or jacketed, in diameters up to 36" — and these huge sections snap over pipe in less time than it takes to tell. Application couldn't be easier or more economical.

Consider, too, that Snap*On is permanent, yet reusable, and that its thermal efficiency rates with the highest of any general purpose pipe insulation on the market. Better yet, actually compare Snap*On the next time you insulate by asking your G-B Snap*On distributor to make a TEVA (Thermo-Economic Value Analysis) survey of your requirements.

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252 W. 10th ST., KANSAS CITY, MO.

Thermal and acoustical glass fiber insulations • Pipe couplings and fittings
Molded glass fiber pipe insulation

CALENDAR

National Assn. of Corrosion Engineers, Western Region Meeting, Hotel Statler.
Nov. 17-19 Los Angeles, Calif.

American Institute of Mining, Metallurgical and Petroleum Engineers, 4th Conference on Magnetism and Magnetic Materials, Sheraton Hotel.
Nov. 17-20 Philadelphia, Pa.

9th National Conference on Standards, Hotel Roosevelt.
Nov. 18-20 New York, N. Y.

Chemical Institute of Canada, Topic: Export for Growth, Sheraton-Mt. Royal Hotel.
Nov. 18 Montreal, Que.

American Institute of Chemical Engineers, North Jersey Section, Lecture: Azeotropic Distillation, University of Delaware (fee charged for attendance).
Nov. 20 Newark, Del.

Scientific Apparatus Makers Assn., Industrial Instrument Section, midyear meeting, The Cloister.
Nov. 20-23 Sea Island, Ga.

American Ceramics Society, New York Section, dinner meeting, topic: Application of Ceramics in Rockets and Missiles, 43rd-St. Brass Rail.
Dec. 3 New York, N. Y.

American Institute of Mining, Metallurgical and Petroleum Engineers, 16th Electric Furnace Conference, Statler Hotel.
Dec. 3-5 Detroit, Mich.

American Chemical Society, 14th Southwest Regional Meeting, Hilton Hotel.
Dec. 4-6 San Antonio, Texas

The Material Handling Institute, annual meeting, Roosevelt Hotel.
Dec. 7-9 New York, N. Y.

American Institute of Chemical Engineers, 51st annual meeting, Netherland Plaza Hotel.
Dec. 7-10 Cincinnati, Ohio.

American Nuclear Society, annual meeting, Sheraton-Cadillac Hotel.
Dec. 8-10 Detroit, Mich.

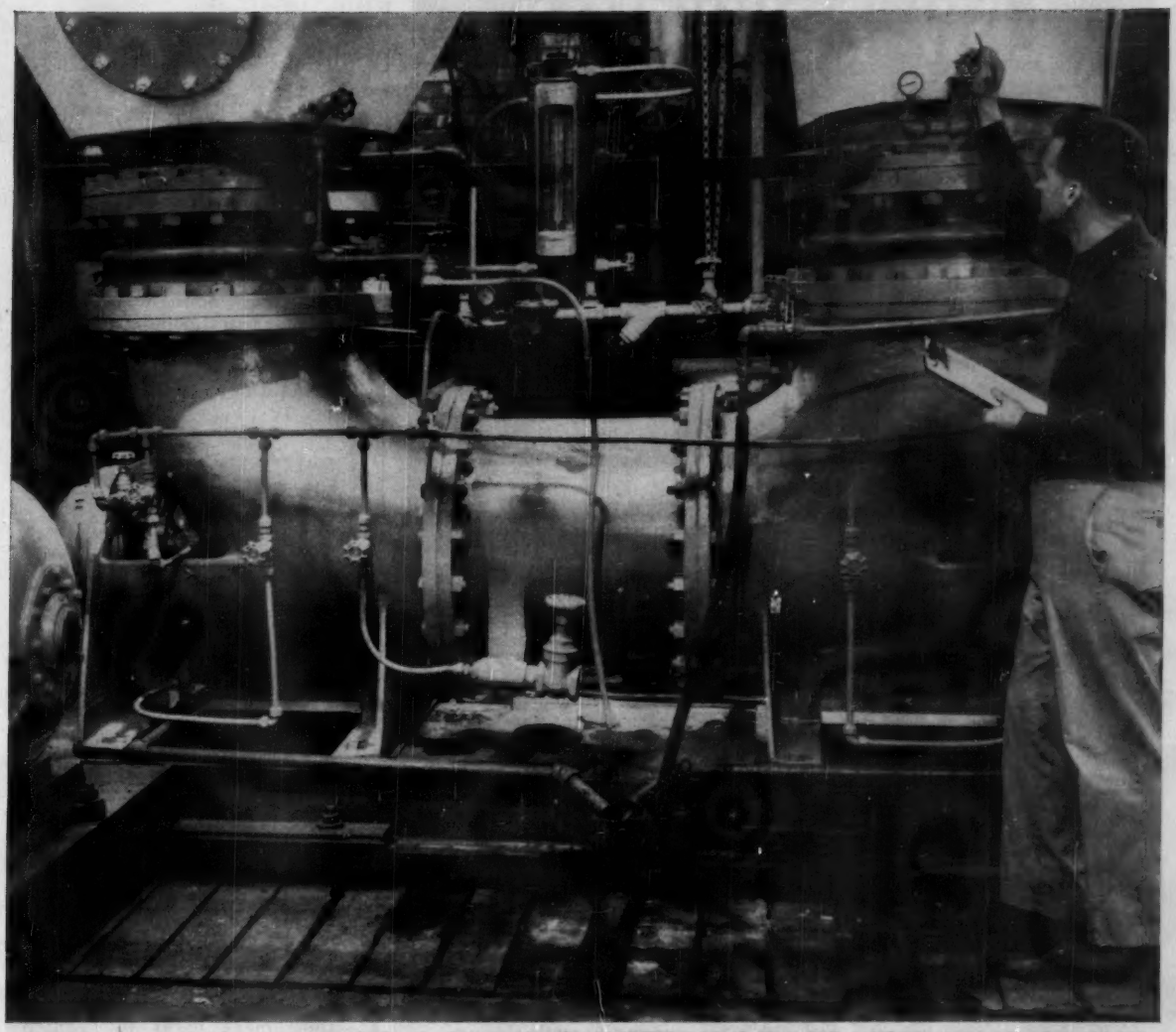
Chemical Specialties Manufacturers Assn., 45th annual meeting, Commodore Hotel.
Dec. 9-11 New York, N. Y.

American Institute of Mining, Metallurgical and Petroleum Engineers, Utah Section Meeting.
Dec. 11 Salt Lake City, Utah

American Chemical Society, Southeast Regional Meeting, University of Florida.
Dec. 11-13 Gainesville, Fla.

American Assn. for the Advancement of Science, annual meeting, Hotel Statler.
Dec. 29-30 Washington, D. C.

American Institute of Chemical Engineers, North Jersey Section, Topic: Oil and Chemicals from Sasol Process, Shulton Lab.
Jan. 6 Clifton, N. J.



One of two new axial flow pumps made for the International Salt Company by Morris Machine Works of Baldwinsville, N. Y. This 24-inch, Type 316 stainless pump recirculates 14,000 gallons of salt slurry per minute through an evaporator.

Type 316 stainless pump thrives on salt diet —gulps abrasive slurry for 18 years, non-stop

In 1940, International Salt Company installed two Type 316 stainless steel Morris flow pumps at its Watkins Glen, N. Y. refinery. Their job: recirculate salt slurry through evaporators. Except for a 1952 overhaul on one pump, they've been in 'round-the-clock service ever since! And in 1955, when facilities were expanded, two new 316 stainless steel pumps were added. (See photo above)

Salt slurry can be hard on pumps — its corrosive action and sharp crystals eat away many common pump materials.

But Nickel-containing Type 316 stainless steel (17% Cr, 12% Ni, 2% Mo) is specially suited for such corrosive-erosive duty — it's tough, strong, resists wear and abrasion . . . doesn't corrode to hamper moving parts . . . protects product purity.

When your equipment must take abrasive-corrosive conditions, look to Nickel-containing stainless steel . . . often the most practical material you can specify.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO NICKEL

NICKEL MAKES ALLOYS PERFORM BETTER LONGER

NEW EQUIPMENT . . .

(*Continued from p.* 90)

As the operator dials any one of 100 stations (1,000 if cascaded), the field selector verifies interrogated station and connects the transducer to system. After signal decoding and triple checks on accuracy, the data, as well as station and function identification, display on the receiver console unit.— **Texas Instruments Inc., Houston, Tex.** 90C

Rotameter Transmitter

Converts float position to pneumatic signal.

Known as the MPT-50, a new instrument helps to keep rotameters in pace with modern process control. In essence, MPT-50 magnetically converts the linear motion of a rotameter float into a rotary motion for subsequent transmission as a pneumatic signal.

Motion conversion depends on the interaction between an iron-strip helix and a rotameter-float extension having a small magnet embedded in it. Through an action analogous to that of a rack and pinion, the leading edge of the helix, constantly attracted to the magnet, transforms extension-rod movements to rotary motion of a special cam. Cam curvature is the same as a polar-coordinate plot of the rotameter calibration curve.

Acting through a cam-follower, a multiple-nozzle sensing system puts out a 3- to 15-psig. signal that is linear to flow rate over a range of 10-100%. An

electric transmitter and a flow integrating mechanism are also available. — **Brooks Rotameter Co., Lansdale, Pa.** 192A

Mass Flowmeter

Single meter body contains all required parts.

Recently introduced at the 1958 ISA Show, a new compact instrument for mass flow rate measurement has only one moving part. The manufacturer claims that the flowmeter eliminates the need for operator adjustments, sampling equipment, and separate instrumentation for specific-gravity measurement.

Two hydraulically matched metering components—a variable force element and a volumetric element—share space in a single meter body. Force element produces a voltage proportional to the product of density times flow rate squared (ρQ^2). Volumetric element puts out a signal proportional to flow. By dividing, electronically, the latter into the former, the device gives an accurate ($\pm 1\%$) indication of mass flow.—**Fischer & Porter Co., Hatboro, Pa.** 193A

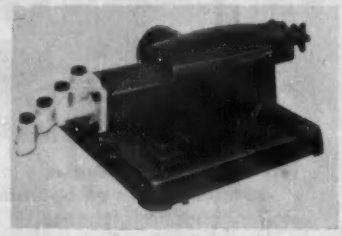
Moisture Indicator

Process unit continuously measures H_2O content.

Designed for continuous operation, the Moisture Monitor electrolytically measures water content of liquid process

streams. The instrument, safe for use in hazardous plant areas, is dependable and conservatively designed.

Operation, briefly described, is as follows: A gas-phase sample of the process liquid enters an electrolytic cell; any water vapor present is absorbed and electrolyzed to hydrogen and oxygen. Flow of electrolysis current is directly proportional to the mass flow rate of water. Thus, since the sampling rate stays constant, the current is a direct indication of moisture content in the process stream. —**Consolidated Electrodynamics Corp., Pasadena, Calif. 193B**



Metering Pump

Line accurately feeds liquid chemicals.

A new line of controlled-volume pumps uses a minimum of working parts and bearing surfaces to translate high-speed rotary motion to low-speed reciprocating motion. Capacity, which can be manually or automatically adjusted while the pump is running, closely approximates a linear relationship to pump speed.

Step-Valve liquid ends, constructed of alloy steels, provide repeatable accuracies to ±1%. The new units will pump a maximum of 29 gph. against heads to 1,900 psi.—**Milton Roy Co., Philadelphia, Pa. 194A**

Transducer

Air output proportional to electrical input.

Designed for use in electrical control loops in which the final control element is pneumatically operated, the Type 543 Electro-Pneumatic transducer

new

Struthers Wells

MULTI-ACTION GREASE MIXER

- **30%-80% time savings**
- **better heat transfer**

COMBINATION

Struthers Wells Radial Propeller Agitator
plus Struthers Wells Double-Motion Pitched Paddle and Scraper Blade Agitator

First designed in a laboratory size, the new Struthers Wells "Multi-action" Grease Mixer is now proved in full-scale production service. Results show greatly increased production and up to 4 times more efficient heat transfer.

The mixing principle combines a high-speed radial propeller which gives excellent mixing and shearing of the grease plus the pumping action of a turbine. The second mixing action involves a conventional double motion pitched paddle agitator for folding action and high-efficiency scraping action. This unusual combination provides rapid heat exchange, excellent mixing, dehydration and deaeration.

When you need peak performance grease mixing, call on Struthers Wells.

Struthers Wells Products

PROCESSING EQUIPMENT DIVISION

Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

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STRUTHERS WELLS CORPORATION

WARREN, PA.

Struthers Wells

Plants at Warren and Titusville, Pa.

requires no additional relays or boosters. It accepts d.c. input signals from 1-5 ma. through 10-50 ma., and is adaptable to most electronic controllers. Standard output ranges from 3-15 psi. through 6-30 psi.

In operation, current from the controller flows through a coil suspended in a magnetic field. Resultant coil motion alters the position of a beam that controls air flow from a relay nozzle. Change of nozzle air flow modifies position of a valve that regulates control-air output. Unit is applicable for use in hazardous areas. — **Fisher Governor Co., Marshalltown, Iowa.** 194B

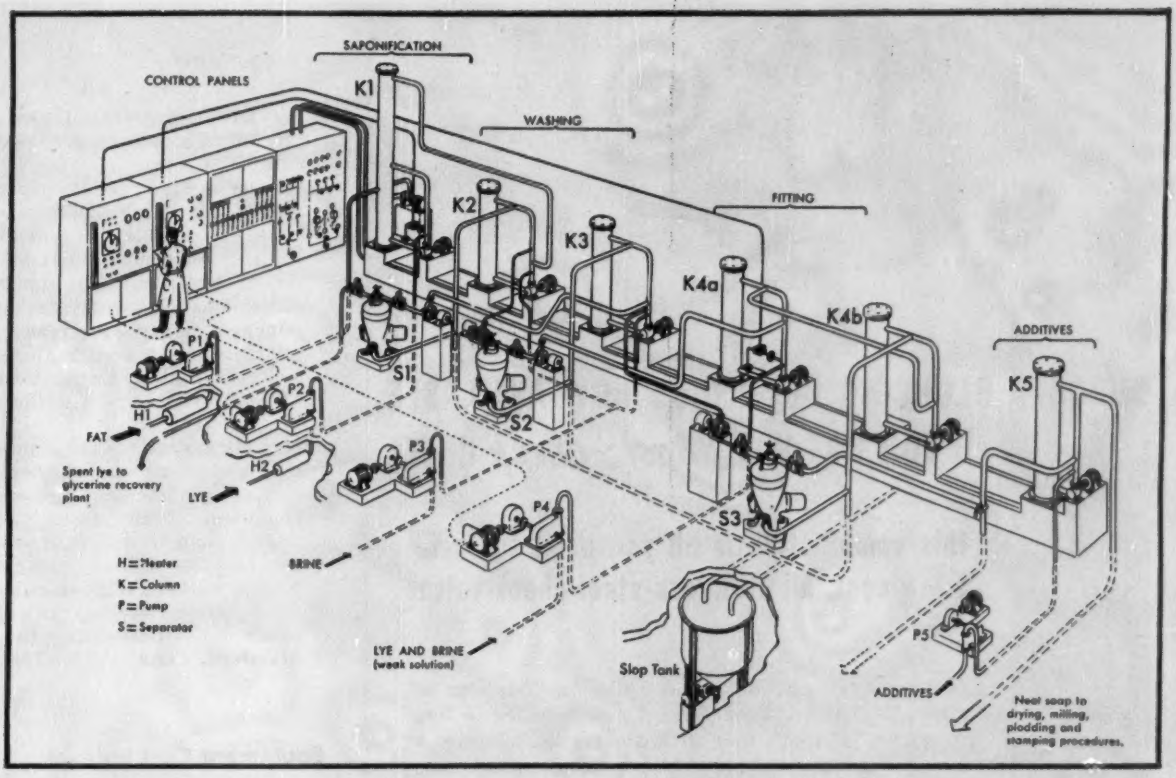
BRIEFS

Globe valves suitable for steam, oil, water and gas lines feature an angle stem that turns flow through only 180 deg. With ratings of 600 psi. at 910 F. for carbon steel and at 1,030 F. for Cr-Mo steel, the valves come in ¼- to 1-in. sizes. Disk is Cr-Co-W stainless alloy; seat is Stellite.— **Edward Valves, Inc., East Chicago, Ind.** 196A

Leakless pump of single-stage, single-suction design will handle costly or volatile liquids at temperatures to 200 F. Available in capacities to 500 gpm. at heads to 250 ft., the pumps require neither mechanical seal nor packing.— **Allis-Chalmers Mfg. Co., Milwaukee, Wis.** 196B

Burner line for operation on gas, oil or a fuel combination provides heat release rates from 3 to 9 million Btu./hr. Packaged unit combines windbox, burner and fan in close-coupled design. — **Coen Co., San Francisco, Calif.** 196C

Flexible hose made of Teflon now comes in diameters up to 3 in. Sold under the Flexlon name, the hose withstands temperatures to 325 F., depending on size and construction. Sterilization of the glass-smooth inner surface permits handling of food products. — **Manhattan Rub-**



"De Laval's 'Centripure Process' makes soap 200 times faster...completely automated."

Fred Wheelwright, De Laval Separator Company

"The traditional batch kettle for soap manufacturing can now be replaced by a completely automatic plant . . . the De Laval 'Centripure Process.' The automated process consists of an hermetically closed system controlled from a central instrument panel.

Change-over to different types of soap is instantaneous . . . simply change the feed material. Heat costs are cut to roughly 1/10 of those for the kettle method. And using *average grade* material, up to 5 tons of high-quality toilet soap can be turned out hourly in a 900-sq. ft. plant.

Enormously accelerated. The Centripure Process converts fat to soap 200 times faster than the batch-kettle method. This is due largely to two factors:

First: Soap already formed is returned to the saponification column (step 1 in the flow-chart). Because of soap's ability to dissolve fat, the reaction is speeded up enormously; also, it results in 99.5% saponification.

Then: De Laval Hermetic Separators divide the soapmass into its components (neat soap from spent lye, neat soap from nigre) and remove all impurities . . . by centrifugal force. This is many times faster than the gravity-settling method. Oxidation and contamination are absolutely eliminated in the hermetically sealed system.

Constant Composition System is what we call our control system. It provides extremely sensitive regulation of the process . . . automatically proportions the raw materials, notes changes in the soapmass and corrects any errors as the process moves along. The basis of the control system is the fact that significant variations in pressure occur with even the slightest changes in the soap composition.

Flow chart. Briefly, here's what happens. Stage 1: **Saponification,** in which lye, fat and already-formed soap are interacted.

Stage 2: **Washing** with brine, liberation of glycerine and separation of lye from the soapmass by centrifugal separation.

Stage 3: **Fitting** . . . a weak brine and lye solution is introduced to form a mixture of neat soap and nigre. The nigre picks up additional glycerine and impurities and is returned to the washing stages. The neat soap goes through the centrifuge.

Stage 4: **Additives** may be used

FOR ADDITIONAL INFORMATION on the De Laval 'Centripure Process,' write to us, or contact your nearest De Laval Sales Engineer. There is no obligation, of course.

DE LAVAL ENGINEERING has pioneered the way for this and many other advances in chemical engineering and processing. The De Laval engineering staff, working in the fully equipped De Laval Pilot and Test Plant, is available for consultation on all your processing problems in which centrifugal separation may be profitably applied. Your inquiry will be handled with dispatch, and without obligation to you."

DE LAVAL
SEPARATOR COMPANY

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York
Chicago, Illinois

DE LAVAL PACIFIC COMPANY,
201 E. Millbrae Avenue, Millbrae, Calif.

NEW EQUIPMENT . . .

ber Div., Raybestos-Manhattan, Inc., Passaic, N. J. 196D

Computer auxiliary input-output system for the LGP-30 machine has simple, convenient controls for complete flexibility of operation. Unit comes either as a combination punched paper-tape reader-punch, or as a reader alone. —**Royal McBee Corp., Port Chester, N. Y. 198A**

Bleaching system for pulps produced by chemical, semichemical and mechanical processes comprises both new and proven designs. Heart of system is the Oliver vacuum bleach washer. Built-to-order for high effectiveness at any user's mill.—**Dorr-Oliver Inc., Stamford, Conn. 198B**

Equipment Cost Indexes . . .

	June 1958	Sept. 1958
Industry		
Avg. of all	230.7	230.9
Process Industries		
Cement mfg	222.2	223.3
Chemical	231.7	232.3
Clay products	216.0	217.0
Glass mfg	218.8	219.3
Paint mfg	223.1	222.8
Paper mfg	223.3	223.8
Petroleum ind	227.9	227.5
Rubber ind	230.7	230.3
Process ind. avg.	228.2	228.6
Related Industries		
Elec. power equip	234.3	236.0
Mining, milling	233.1	233.7
Refrigerating	260.7	260.3
Steam power	218.4	218.1

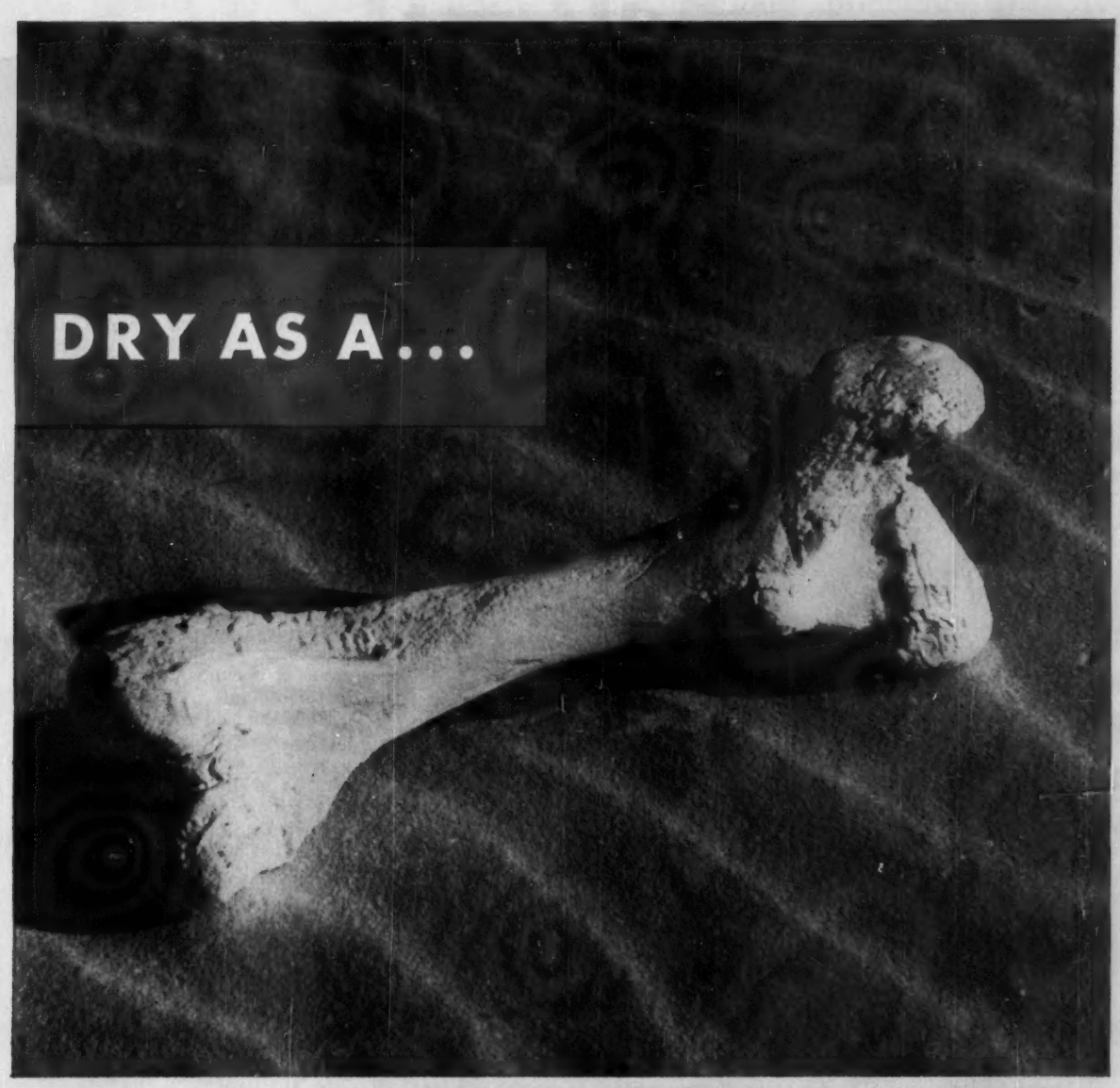
Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 125–6 for method of obtaining index numbers; Feb. 24, 1958, pp. 143-4 for annual averages since 1913.

For More Information . . .

about any item in this department, circle its code number on the

Reader Service

postcard (p. 207)



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TECHNICAL

With Industrial Emphasis

COMPREHENSIVE INORGANIC CHEMISTRY, Vol. 7: The Elements and Compounds of Group IV-A. By H. P. Klug and R. C. Brasted. Edited by M. C. Sneed and R. C. Brasted. D. Van Nostrand Co., Princeton. 302 pages. $6.

Reviewed by Kenneth A. Kobe, Department of Chemical Engineering, University of Texas, Austin, Tex.

Elements of group IV-A, carbon, silicon, germanium, tin and lead, and their important inorganic compounds, are discussed in this volume.

Thus the field of organic chemistry is excluded, but not compounds in which carbon is tied directly to the other elements of this group, the organometallic compounds. Chapter 3 (22 pages) is devoted to the organosilicon compounds. The other organometallic compounds are discussed briefly in the chapter on the element and its inorganic compounds.

This volume follows the general pattern of preceding volumes. An introduction gives the general characteristics of the group and tabulates the physical and thermodynamic properties of the elements. An extensive table lists the isotopes and their radioactive properties.

First chapter gives considerable detail on the preparation and properties of carbon in several forms. A thorough discussion is given of the relatively few compounds of carbon such as calcium carbide, carbon disulfide, carbon halides, carbon dioxide, monoxide, suboxide, and the carbonyl halides. Second chapter discusses silicon and its important compounds, now including hydrides; the third covers organosilicon compounds, the fourth, silicate chemistry (65 pages)—natural silicates, soluble silicates, glass, Portland cement and slags. Individual chapters on germanium, tin, and lead and

BOOKSHELF

J. B. BACON

their compounds follow in order. Final chapter discusses the metallic borides, carbides, silicides and such related compounds as nitrides, phosphides, arsenides, bismuthides, and hydrides.

▶ **Industrial Emphasis** — Like the preceding volumes, this book is an excellent reference to the important properties of the elements of this group and their compounds. Industrial uses are emphasized because of the great importance of four of the elements. The special chapters on organosilicon compounds and silicate chemistry are most useful.

In contrast to the tables of accurate data are the tables of statistics for 1945, 1946 or earlier. Surely a 1958 book should have later statistics:

"Gasolines leaded to an octane rating of 80 or higher are known as Ethyl or premium gasolines."

Those were the good old days!

With the completion of seven of the proposed eleven volumes, the set now covers a greater proportion of the periodic table and its usefulness is thereby enhanced.

BRIEFLY NOTED

BIBLIOGRAPHY OF INVESTMENT AND OPERATING COSTS FOR CHEMICAL AND PETROLEUM PLANTS, July 1954-December 1956. Information Circular 7847. *Compiled by Sidney Katell, U. S. Bureau of Mines. Publications-Distribution Section, Bureau of Mines, 4800 Forbes Ave., Pittsburgh 13, Pa.* Fourth in a series of bibliographies; lists over 500 articles and publications.

REPORT ON THE PRODUCTIVE USES OF NUCLEAR ENERGY: NUCLEAR PROCESS HEAT IN INDUSTRY. *44 pp. By George Perazich. National Planning Assn., 1606 New Hampshire Ave., N. W., Washington 9, D. C. $1.25.* Describes and discusses types and costs of energy used by manufacturing industries; analyzes potential use of nuclear process heat in 11 selected industries, including petroleum and chemical industries.

LETTERS:

More on Thermal Shock

Sir:

We are extremely pleased with the manner in which you discussed glassed steel in your September 8 feature report on nonmetallic inorganics.

On p. 132 you listed a thermal shock temperature differential for glassed steel of 305 F. It is our practice when quoting thermal shock temperature differentials to relate them to a specific vessel operating temperature. For example, at a vessel temperature of 250 F., the ΔT value = 260 F., whereas at a vessel temperature of 450 F. the ΔT value = 150 F. Since thermal shock resistance of glassed-steel equipment varies with vessel temperature, there is no standard value which can be generally applied.

DONALD C. DEYLE
Pfaudler Co.
Rochester, N. Y.

It Jes' Ain't Normal

Sir:

My brother, Al, recently wrote you that Celanese was also producing butyl alcohol, and you acknowledged his letter in your Oct. 6 edition (p. 194).

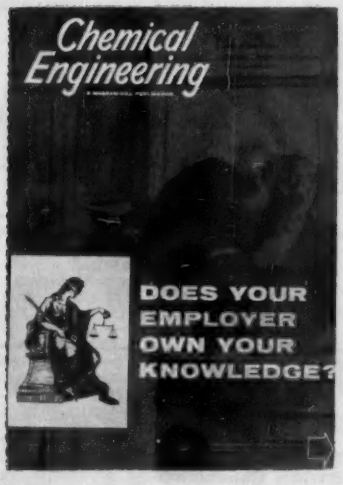
What he neglected to tell you was that the rest of our family (the Butyls) are trying to produce butyl alcohol down here in the hills (like our pappy did before us), but it keeps coming out ethyl alcohol instead! We haven't figured out what's wrong yet, but our sister, Ethyl, is working on it in the lab (maybe that's what's wrong!).

PRO & CON

C. H. CHILTON

Just thought you ought to know the latest.

NORM BUTYL
Al-Co-Hol, Ink.
Moonshineville, Ky.



Art for Art's Sake

Sir:

I don't find any credit given for the front cover illustration of your July 28 issue.

Isn't this illustration one-half of a reversed reproduction from an original in the Philadelphia Museum of Art?

JOHN ABBOTT
Food Machinery & Chemical
San Jose, Calif.

► *Reader Abbott knows his paintings, as confirmed below.*

Sir:

Your July 28 cover is a reproduction of a painting by H. Daumier, titled "Une Cause Celebre (A Famous Case)." It has been on anonymous loan to the Philadelphia Museum since 1951.

This painting was formerly in the Boulard, Bureau and Morel d'Arleux collections. It was exhibited in Paris exhibitions in 1900, 1901, 1927, 1931 and 1934, and in the Daumier exhibition at the Philadelphia Museum of Art in 1937.

MARJORIE E. LYONS
Philadelphia Museum of Art
Philadelphia, Pa.

READER SERVICE . . .

TECHNICAL

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Chemicals

Alcohol, Denatured . . . . . Citric acid may now be added to toilet preparations containing tartar emetic to prevent clouding according to an industry circular.
37-38d *U. S. Industrial Chem. Co.

Barium Chloranilate . . . . . reagent powder for sulfate determinations is now being marketed. Suitable for analyses of water, petroleum products, many other materials.
37-38g *U. S. Industrial Chem. Co.

2-Butene & 1-Butene.....High purity concentrates are now commercially available. The 2-butene contains no isobutylene, the 1-butene contains 5% max. isobutylene.
37-38k *U. S. Industrial Chemicals

Catalyst Carriers.....Alundum catalyst carriers & supports are fully outlined in Bulletin No. 7. Offer excellent thermal & chemical stability.
133 *Norton Co.

Chemicals.....Feed industry outlook for next 50 years covers expected advances in farm economics, biochemical developments, feed automation, in reprint form.
37-38i *U. S. Industrial Chem. Co.

Chemicals, Electronic.....Chemicals in which critical impurities are controlled to extremely low levels. Complete specifications on these electronic chemicals available.
188 *Mallinckrodt Chemical Works

Cement....."The Preparation of Magnesium Oxychloride Cements with Westvaco Oxychloride Magnesia," 15 p., covers uses, standards, chemistry, and physical changes.
204A Westvaco Min. Prod. Div.

Clays....."Harwick Clays in Rubber" is a new 2-p. bulletin which describes a new addition to the company's line of water-fractionated clays.
204B Harwick Standard Chemical Co.

* From advertisement, this issue

LITERATURE

E. M. FLYNN

Dimethyl Ethers.....Physical, chemical properties, specifications, uses on 4 ethers in 23 p. booklet designed for readers whose firms use solvents in manufacturing.
205A Ansul Chemical Co.

Fluorides, Double.....For further information, samples or technical assistance on seven double fluorides. Part of a wide range of fluorides manufactured.
67 *Allied Chemical Corp.

Fluorolubes.....a high-density polymer of trifluorovinyl chloride. It's available in many grades...all are excellent lubricants. Specifications & properties in Data File.
1c *Hooker Chemical Corp.

Hydrogen Peroxide.....A new booklet is available on epoxidation & hydroxylation with hydrogen peroxide as a means of upgrading olefins. Contains facts & applications.
85 *Allied Chemical Corp.

Isopropyl Alcohol.....Complete information on specifications & performance characteristics of Isopropyl alcohol & many other high quality petrochemicals is available.
199 *Enjay Company, Inc.

Isosebacic Acid.....Esters of Isosebacic acid compare well with other vinyl plasticizers. Isosebacic acid is a new synthetic intermediate, available soon.
37-38c *U. S. Industrial Chemicals Co.

Laminate, Plastic.....Bulletin 4.5.1, 4 p., describes Grade G-5, a laminated plastic characterized by high tensile and flexural strengths plus high arc and flame resistance.
205B Taylor Fibre Co.

Magnesium Oxide.....A test sample of low-iron, low-lime MgO in any of its three forms; powdered, pelletized or granular, is yours for the request.
125 *International Minerals & Chemical

Marasperses.....to stabilize oil-in-water emulsions. Also used in the preparation of wax sizings, industrial cleaners, etc. Illustrated booklet No. 119 gives details.
205c Marathon Corp.

* From advertisement, this issue

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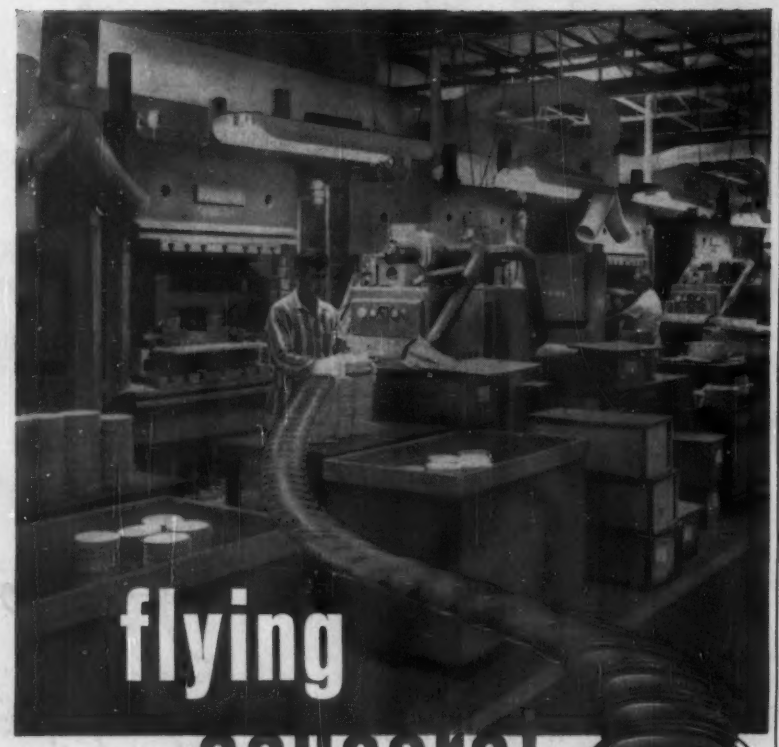

flying saucers!

Two reliable, packaged Cleaver-Brooks boilers maintain high-speed production of Texas-ware and Dallas-ware melamine dishes for Plastics Mfg. Co., *Dallas*

Chief engineer, W. L. Cone, Jr., states: *"Consistently dependable steam supply is keynote of our plant operation. That's why we chose two Cleaver-Brooks gas-fired boilers for our steam source.*

"One feature we appreciate about these new boilers is the easy access to their internals. Not only does this facilitate frequent inspections but also it greatly reduced their cost. There are no joints that require re-sealing every time the boiler is opened. Being hinged and davited, the doors and heads do not have to be hoisted for removal. Six bolts can be removed in less than two minutes."

Guided by experience

"Based on nine years of unfailing performance delivered by two 50-hp Cleaver-Brooks boilers we used in our former plant, there never was any question that we would install their equipment in our new plant," said Mr. Cone.

Architects for the new plant were: Thomas, Jameson and Merrill; Consulting engineers: Zumwalt and Vinther; General contractor: Carpenter Bros.; Mechanical contractor: Beard Plumbing Company, all of Dallas.

"Our 125-hp, 250-psi design pressure, gas-fired Cleaver-Brooks boilers provide all steam for compression-molding presses, office space heating and hot water heating" — W. L. Cone, chief engineer.

Cleaver-Brooks packaged boilers are America's largest selling packaged boilers. Available in 19 sizes 15-600 hp, 15-250 psi. Oil, gas or combination oil/gas fired. For complete information contact nearest representative or write: Cleaver-Brooks Co., Dept. CE-118, 345 E. Keefe Ave., Milwaukee 12, Wisconsin, USA.

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Cleaver Brooks®

LITERATURE . . .

Methionine..... is an essential sulfur amino acid, a precursor of cystine in the skin, hair, nails & other tissues. Tests conform that it is absorbed through the skin.
37-38b *U. S. Industrial Chemicals Co.

Mineral Filler.....Celite comes in a wide range of grades. Controls package loss in cleansers, adds needed bulk to paper, cuts cost of formulating insecticide dusts, etc.
16-17 *Johns-Manville

N-Bromosuccinimide....."NBS, Its Re actions & Uses," 42 p., by Thomas D. Waugh, describes reactions, uses, special field of use, i.e. steroids. Send for your Copy.
206A Arapahoe Chemicals, Inc.

Plastics.....A complete line of PVC pipe, fittings & valves are described in Bulletin PF-1200. Linings, molded parts, fabricated parts & roll coverings available.
194 The Luzerne Rubber Co.

Plastics, Reinforced.....4 p. brochure titled "Fiber Glass Reinforced Plastic Moldings for the Product Designer" describes variety of physical properties reinforced plastics allow.
206B Winner Mfg. Co.

Polyethylene.....New surface treatment for polyethylene makes it receptive to printing ink. Two types of chemical solutions are mentioned in patent.
37-38e *U. S. Industrial Chemicals Co.

Polyvinyl Chloride.....This lightweight rigid plastic licks more than 280 corrosive liquids & gases. Operates at temperatures up to 212 F. Non-sparking & nonmagnetic.
144b *Joseph T. Ryerson & Son, Inc.

Powdered Replacement.....for liquid acids is blend of acid salts, activators, surfactants. Suggested for activating metals before plating & as pickling agent.
37-38f *U. S. Industrial Chemicals Co.

Rauwolfia Alkaloid Raubasine.....is now available in commercial quantity. Product is also known as ajmalicine, delta-yohimbine & tetra-hydroserpentine.
37-38i *U. S. Industrial Chemicals Co.

Reagents, Grignard.....For a line of Grignard reagents, 4 p. bulletin gives uses, standardization, recommended handling procedure, shipping regulations.
206C Arapahoe Special Products, Inc.

Resins.....22 p. bulletin, "Water-Soluble resins for Industrial Finishes," describes Arolon 1000, new resin permitting water-soluble paint formulations.
206D Archer-Daniels, Midland Co.

Sodium Chlorate.....Booklet tells all accepted precautions used in handling & storing. Lists physical & chemical properties & illustrates them with graphs & charts.
1a *Hooker Chem. Corp.

Sodium Dispersions.....Dispersion Reactor can be used to increase the surface area of sodium for faster reactions & higher yields in purifications, metallations, etc.
37-38a *U. S. Industrial Chemicals Co.

Solvants.....Booklet "Shell Aromatic Solvants for the Coatings Industry" gives typical properties of Toluene, Xylene, Cyclo-Sol 53, and TS-28 solvents.
69 *Shell Oil Company

* From advertisement, this issue

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1a	22-23	37-38j	85	85	99	119	133	181c	L194	202d	210A	216	BL221	230
1b	24-25	37-38k	86	86A	100	120	134	182	R194	203a	210B	216A	R221	231
1c	26-27	37-38l	87	86B	101	121	135	183	195	203b	210C	216B	222	L232
1d	28-29	37-38m	88	86C	102	122	140	184	196	203c	210D	216C	222A	R232
4a	30-31	39	89	86D	103	123	141	185	196A	203d	210E	217	222B	240
4b	32	40-41	90	86E	104	124a	144a	186	196B	204	211	218A	TL223	241
4c	33	42	62	87	105	124b	144b	187	196C	204A	212	218B	BL223	L242
4d	34	43	67	88A	106a	124c	167	188	196D	204B	212A	218a	R223	R242
4e	35	44	69	89	106b	124d	169	189	197	205	212B	218b	224	TL243
4f	36	45	71	90A	107	124e	171	190a	198	205A	212C	TL219	TL225	BL243
6	37-38a	46	73	90B	109	124f	173a	190b	199	205B	212D	BL219	BL225	R243
7	37-38b	47	75	90C	110	125	173b	192	198A	205C	213	R219	R225	244a
8	37-38c	48	77	91	111	126	173c	192A	198B	206	214	220	226	244b
9	37-38d	49	79	92	112	127	175	193	200	206A	214A	220A	L227	245
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18-19	37-38h	53	84B	96	116	131	181a							

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- ADS
- EQUIPMENT Page 88
- PRODUCTS Page 84
- SERVICES
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63	64	65	66	67	68	69	70	72	73	74	75	76	78	79	80	81	82	83	84	85	86
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1b	24-25	37-38k	86	86A	100	120	134	182	R194	203a	210B	216A	R221	231
1c	26-27	37-38l	87	86B	101	121	135	183	195	203b	210C	216B	222	L232
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4e	35	44	69	89	106b	124d	169	189	197	205	212B	218b	224	TL243
4f	36	45	71	90A	107	124e	171	190a	198	205A	212C	TL219	TL225	BL243
6	37-38a	46	73	90B	109	124f	173a	190b	199	205B	212D	BL219	BL225	R243
7	37-38b	47	75	90C	110	125	173b	192	198A	205C	213	R219	R225	244a
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1a—Sodium Chlorate
1b—Sulfides
1c—Fluorolubes
1d—Trichlorethylene
4a—Horizontal Pan Type Vacuum Filter
4b—Oscillating Screen Centrifuge
4c—Pressure Leaf Filter
4d—Solid Bowl Centrifugal
4e—Drum Type Vacuum Filter
4f—Batch Centrifuge
106a—Protectocate Neoprene Gloves
106b—Plastifab Vinyl Plastic Gloves
124a—Filters (All types mentioned)
124b—Vertical Leaf Filter
124c—Vertical Batch Filters
124d—Horizontal Leaf Filters
124e—Horizontal Batch Filters
124f—Cartridge Filters
144a—Stainless Steel
144b—Polyvinyl Chloride
173a—Model P "Karbate" Impervious Graphite Pump
173b—Porous Carbon Filter Tubes
173c—Activated Carbon CXC 4/6
181a—Roller Bearings
181b—Taper-Lock Sheaves
181c—Taper-Lock Sprocket
190a—Gaskets
190c—Joints, Expansion
202a—Ace-ite, High Impact Rubber-Plastic
202b—Rubber or Plastic Lining
202c—Plastic Valves for Matched Systems
202d—Pachydermous Pail
203a—Rivicior
203b—New Ace Gear Pump
203c—Chemical Valves
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LITERATURE . . .

Sulfides.....in a new drum that empties faster, more safely. Flakes never pile up around opening. Information on sodium sulfide & sodium sulfhydrate in drums is offered.
1b *Hooker Chemical Corp.

Trichlorethylene.....A forty page booklet included physical & chemical properties, reference to handling & storage procedure. Also a section on safety measures.
1d *Hooker Chemical Corp.

Construction Materials

Alloys.....Four types of Hastelloy alloys, each specifically designed to resist certain corrosives. 104-page booklet gives properties & fabrication information.
175 *Haynes Stellite Co.

Aluminum.....A comprehensive set of literature related to the use of aluminum in high purity water systems is available. Aluminum condenser tube report included.
26-27 *Aluminum Co. of America

Bus Bars, Aluminum.....feature excellent corrosion resistance. For use in process plants. Complete information contained in Bus Conductor Handbook, AD661.
210A Aluminum Co. of America

Coating.....Kanigen nickel-alloy coatings provide corrosion resistance & product contamination protection to process equipment of any size.
134 *General Amer. Transportation Corp.

Coating.....4 p. fully illustrated brochure outlines the properties and advantages of Hydrocide Colorcoat, heavy-bodied textured decorative coating for exterior masonry.
210B L. Sonneborn Sons, Inc.

Coatings.....36 p. brochure provides information on clear and colored coating for use on metal, plastics, glass, wood, via spraying, screening and roller coating.
210C Bee Chemical Co.

Fabrication.....Brochure "Working With Metal" gives factual information on designing, engineering and specialized fabrication in chemical processing.
205 *The Boardman Co.

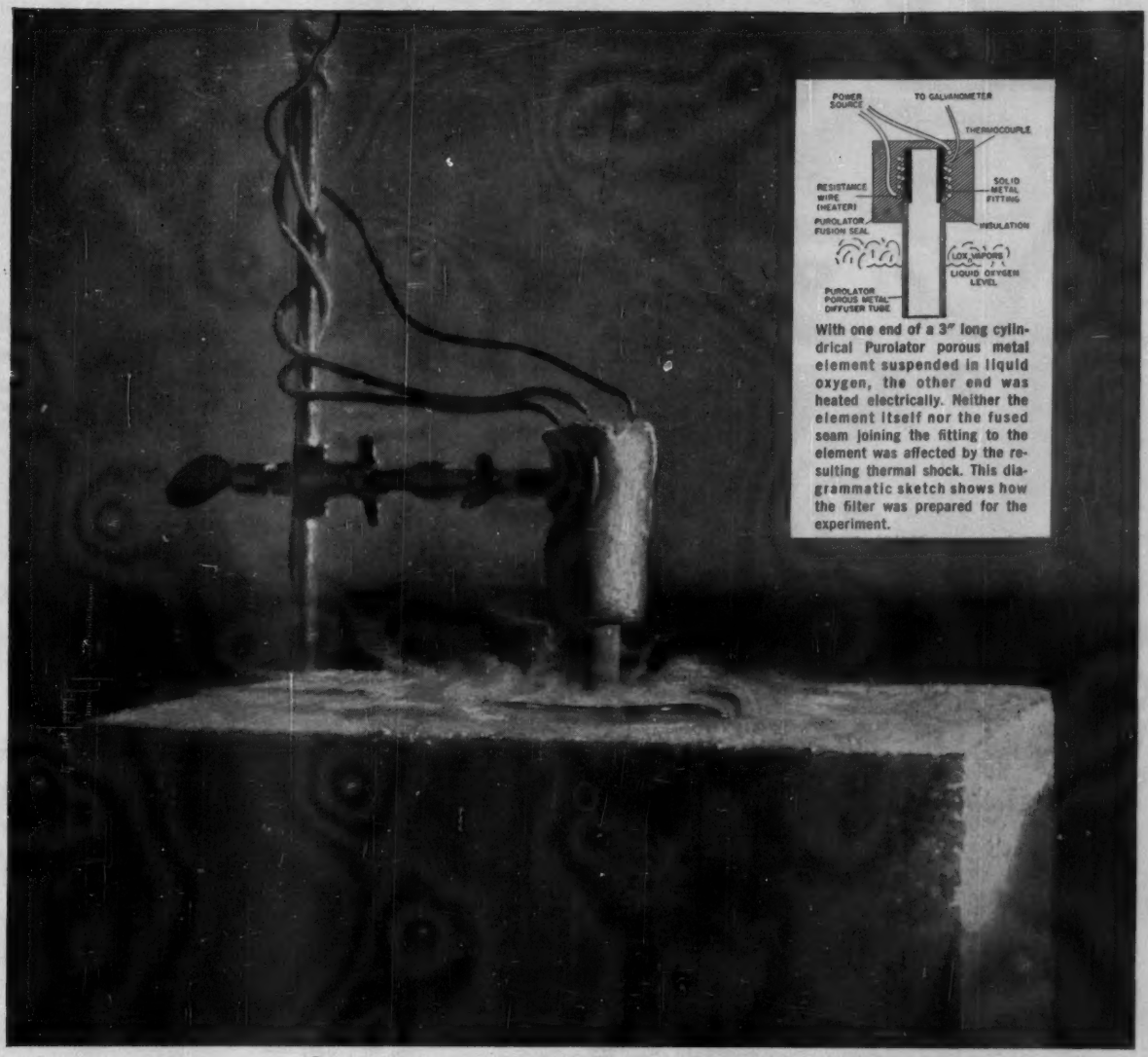
Floors, Industrial.....resistant to widest range of acids, alkalies & solvents. Constructed of acid brick & joined with corrosion proof cement. Bul. 3-3.
R242 *Atlas Mineral Products Co.

Insulation.....4 p. bulletin give information on insulating cement for high temperature boilers, ovens, ducts, headers, turbines, valves, piping, kettles, heat exchangers.
210D U. S. Mineral Wool Co.

Insulation Products.....for all users of temperature...for power, processing, air conditioning or cold storage. Performance & specification data bulletins offered.
129 *Mundet Cork Corp.

Plastic Products.....New 32-page catalog covers the manufacturer's complete line of plastic products made from Teflon, Raylon and Kel-F. Packings, gaskets, hose, etc.
210E Raybestos-Manhattan

* From advertisement, this issue



With one end of a 3" long cylindrical Purolator porous metal element suspended in liquid oxygen, the other end was heated electrically. Neither the element itself nor the fused seam joining the fitting to the element was affected by the resulting thermal shock. This diagrammatic sketch shows how the filter was prepared for the experiment.

Filters for extreme conditions . . .

THERMAL SHOCK

Purolator metal filter media can take it

How much thermal shock can a filter withstand?

In a recent series of experiments, various samples of Purolator metal filter media stood up under temperature gradients, across short lengths, of up to 500°F...and could have taken more. There was no effect on filter efficiency.

Thermal shock is only one of the difficult operating problems Purolator's staff of "Q" and "L" cleared-filtration experts handle regularly. They can design and produce the exact filter needed to remove any known contaminant from any known fluid under any operating conditions. They have produced filters and separators to operate within the following wide ranges of conditions:

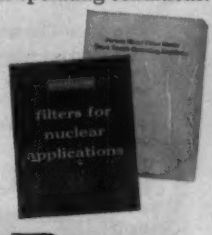
TEMPERATURES: from −420° to 1200°F.

PRESSURES: from a nearly perfect vacuum to 6,000 psi.

RATES OF FLOW: from drop by drop to thousands of GPM.

DEGREES OF FILTRATION: from submicronic to 700 microns (in various media).

No other filter manufacturer can offer such complete services to handle so wide a range of tough operating conditions. These brochures outline what Purolator can do for you, or, if you have an urgent filtration problem, call Jules Kovacs, Vice President in charge of Technical Sales... or send him the details of your application.



Filtration For Every Known Fluid

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PRODUCTS, INC.

RAHWAY, NEW JERSEY AND TORONTO, ONTARIO, CANADA

LITERATURE . . .

Stainless Steel.....With 2351 kinds & sizes of sheets, plates, bars, tubing, pipe & fittings in stock. Facts about this anti-corrosive material is available.
144a *Joseph T, Ryerson & Son, Inc.

Stair Treads, Aluminum.....are available in all standard sizes. They need no paint. Aluminum grating also available, for floors & walkways. Bulletin AD679.
212A Aluminum Co. of America

Sheet & Strip.....Manual giving details of stainless steel strip & sheets is available. Extremely close tolerances in widths up to 48 inches. Send for your copy.
39 *Jones & Laughlin Steel Corp.

Steel Grating.....Rigid, one-piece construction makes installation easy. New ideas about grating, including space saving platforms & shelving in Bul. 2486.
96 *Blaw-Knox Co., Equip. Div.

Tantalum....."Corrosionomics", a journal of useful information for the solution of corrosion problems. Technical data on Tantalum, its uses & properties.
230 *Fansteel Metallurgical Corp.

Towers, Packed.....Bulletin TA-30 gives data on packing support, plates, how to install; when to redistribute, & other data helpful to designers of packed columns.
60 *U. S. Stoneware

Tread Plates.....available in standard aluminum and also bonded abrasive surface for extra non-skid protection. Complete information in Bulletin AD596.
212B Aluminum Co. of America

Wire Cloth.....Full data is supplied in "Engineers Manual of Wire Cloth Strainer Design" to aid engineers responsible for design or use of wire cloth strainers.
212C Michigan Wire Cloth Co.

Wire Cloth & Screen.....resists distortion, corrosion, heat & pressure. Condensed Screen Reference Catalog gives specifications and other details.
201 *Ludlow-Saylor Wire Cloth Co.

Electrical & Mechanical

Coupling, Flexible.....Revised bulletin covers new additions to the Sure-Flex line of flexible couplings. Selection data and engineering tables included.
212D T. B. Wood's Sons Co.

Couplings.....for the safe transfer of every types of product through hose or pipe. Shank hose coupling, adapter & coupler, dust plug, etc. are available.
232 *Ever-Tite Coupling Co., Inc.

Couplings.....Controlled Torque model incorporates torsional resilience to smother ordinary shock & vibration plus ability to accommodate shaft misalignment. Bul. 4100.
103 *The Falk Corp.

Motors, Fan-Cooled.....confine air stream to surface. Provides extremely efficient cooling & prevents dust & dirt accumulation. Complete details in Bul. 1205.
97 *Fairbanks-Morse & Co.

* From advertisement, this issue

DRYING PROBLEMS?

JUST WRAP 'EM UP AND SEND 'EM TO US!

EXPERIENCE
that helps you cut costs

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CHEMICALS	PHARMACEUTICALS
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PLASTICS	CERAMICS
TEXTILES	PAPER PRODUCTS

and many, many others, covering nearly every product where a drying process exists

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your plant condition and product condition prior to drying can be duplicated, to determine:

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2. How to attain highest production rate in pounds of stock per hour per square foot of drying area, economically.
3. Air flow data
4. Required temperatures
5. Required heating surface
6. Dryer length and design
7. Apron or roller (feeding) speed
8. Exact development of drying curves required.
9. Possible simple changes in stock preparation prior to drying, to attain maximum quality and efficiency.
10. Controls required to maintain quality and quantity drying in uniform, continuous production.

CONSULT THE EXPERTS

Sargent's Drying Research Laboratory offers you an invaluable source of wide experience and practical, down-to-earth knowledge. Wherever there's a drying process, in research or production, our laboratory staff is highly qualified to serve, advise, recommend and, with Sargent engineers, design the proper drying equipment for your particular product.

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HOUSTON 17, TEX. — The Alpha Engineering Co., Box 12371
CHARLOTTE, N.C. — W. S. Anderson, Carolina Specialty Co.
ATLANTA, GA. — J. R. Angel, Mortgage Guarantee Building
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LITERATURE . . .

Power Switching Centers.....are available in ratings from 4.8 through 14.4 kv, 600 through 2000 amp. Also automatic control can be supplied. Information available.
132 *I-T-E Circuit Breaker Co.

Starters.....Air-break high voltage starters feature 3-way padlock protection. They are furnished with a control transformer. Details in Bul. 8130-F.
99 *The Electric Controller & Mfg. Co.

Speed Reducers.....A new line of versatile worm gear speed reducers are designed for heavy duty industrial work. They are fan cooled. Information in Bul. 5018.
169 *De Laval Steam Turbine Co.

Thermistors . . . . . Fifteen different thermistor circuits are described in catalog EMC-2. Also specifications for 400 different thermistors. Send for your copy.
214A Fenwal Electronics, Inc.

Thermocouple Assemblies.....A complete range of assemblies including; thermocouples, connection heads and thermowells. Features simplified ordering. Cat. Section E-E.
L223 *Thermo Electric Co., Inc.

Turbines.....Steam turbines ranging from 150 hp down to fractional in 6 frame sizes. Feature optional carbon ring packing glands. Bulletin 135 gives details.
117 *Coppus Engineering Corp.

Handling & Packaging

Barges.....designed and constructed in every type and specification. A complete, illustrated brochure, "Marine Construction, Vol. 2", is available.
196 *Avondale Marineways, Inc.

Cans....."F" style cans feature fast & easy stacking. Available in a wide range of sizes, from 4 oz. to 1 gal. Broad surface of can provides room for sales message.
93 *Continental Can Co.

Conveying Systems.....Air-line conveying provides fast, sanitary method of unloading, in plant transporting, mixing, & loading any dry materials. Bulletin No. M-588.
214B The Day Company

Conveyor Belts.....Metal-mesh belts for such diversified operations as bagging cement, drying wool, etc. A 130-pg. Reference Manual gives specifications, etc.
212 *The Cambridge Wire Cloth Co.

Drums, Aluminum.....Benson drums for shipping chemicals, corrosives, & liquids that must not be contaminated. Won't contaminate the fluids it handles.
107 *Reynolds Metals Co.

Elevators, Bucket.....New brochure describes a complete line of bucket elevators. Simplified selection data quickens the proper choice of equipment.
214C Chain Belt Co.

Elevators, Screw.....The Super-Lift screw elevator features a drive head from which oil will not leak and contaminate bulk materials being handled.
214D Fort Worth Steel

* From advertisement, this issue

Leaders of the Mallory-Sharon technical team *(l. to r.) Lee S. Busch, Technical Director; Frank H. Vandenburgh, President; Graham B. Brown, Vice President, Marketing; Dan E. Cribbs, General Manager, Wrought Products Division.*

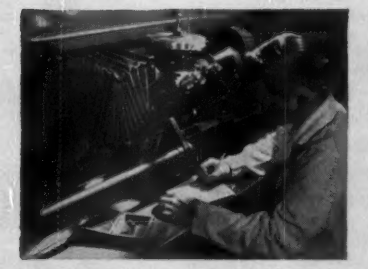
Take a new look at this

SPECIAL METALS TEAM

A whole new family of metals has come "of age" in the past decade. Titanium and zirconium already have progressed from expensive rarities to practical materials of construction. Other special metals will soon join them.

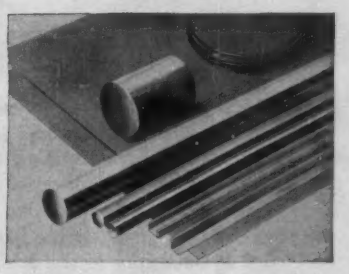
Looking for a fast-moving, on-its-toes "team" to assist you on special metals applications? Mallory-Sharon, largest integrated special metals producer, offers you just such a team. Within one organization, we control production from raw materials to finished mill products. Our entire experience and facilities, backed by a strong Service Engineering group, are devoted to special metals research and application.

To put this team to work for you, just write us about your needs or applications.



Research—*Microphotograph equipment for studying metallurgical grain structures. Mallory-Sharon is currently working on various government research projects, in addition to its own constant research and testing.*

Sponge Production—*Zirconium tetrachloride, delivered in these huge 6-ton rubber containers, is processed into zirconium sponge or platelets at Mallory-Sharon's modern sponge plant in Ashtabula, Ohio.*



Mill Products—*Both titanium and zirconium are available from Mallory-Sharon in sheet, strip, rod, bar, plate and other shapes. All are closely quality-controlled as to mechanical properties and chemical composition.*

MALLORY SHARON

MALLORY-SHARON METALS CORPORATION • NILES, OHIO

Integrated producer of Titanium • Zirconium • Special Metals

LITERATURE . . .

Feeders.....Vane type, assure you of dependable handling of dry, pulverized & granular materials. Built with circular or rectangular outlets. Bulletin.
56 *Fuller Co.

Hoist Truck.....Simplified bulk handling is described in a new brochure that gives helpful details about the Lift-O-Krane combination Broch. 91.
216A Silent Hoist & Crane Co.

Lift Truck.....The FT20-24, 2,000 lb. truck with full load will climb a 40% grade. Full 35 hp at 2,400 rpm. Complete information in new booklet BU-485.
87 *Allis-Chalmers

Lift Truck System.....An industrial truck selector guide shows how to set up material handling systems in relation to specific plant layouts. Brochure avail.
216B Automatic Transportation

Loader.....Model TL-6 has the short, 6½ ft. turning radius & power steering. A descriptive catalog on the complete line of Tract-to loaders is offered.
47 *Tractomotive Corp.

Materials Handling.....Complete data on the new model H-25 Payloader available. Handles more material per hour at less cost per ton. Carry capacity of 2,500 lbs.
8 *The Frank G. Hough Co.

Portable Bag Closer.....Model CR requires no installation, supports or plant space. Available with or without tape binding attachment. Complete catalog file.
BL 225 *Dave Fischbein Co.

Storage Lixator.....A rugged dual-unit for dry-salt storage. Different Lixators tailored to your specific needs. Technical assistance & information.
120 *International Salt Co.

Tank Trailers.....of stainless steel, are extremely easy to clean. Offer high strength & durability at high temperatures. Booklet gives complete information.
131 *Armco Steel Corp.

Tanks.....of carbon & stainless steel for chemical storage. Also pressure vessels & processing equip. of aluminum & special alloys. Booklet "Tank Talks" is offered.
BL 223 *R. D. Cole Mfg. Co.

Heating & Cooling

Absorption Refrigerating Machine..... deliver a total of 19,470 tons of cooling, range in capacity from 60 to 700 tons & help produce explosives, table salt, etc.
36 *Carrier Corp.

Boilers.....available in 19 sizes, 130 models, 15 to 600 hp. . . . steam or hot water, gas, oil, or combination oil/gas fired. Facts on the self-contained boiler offered.
206 *Cleaver-Brooks Co.

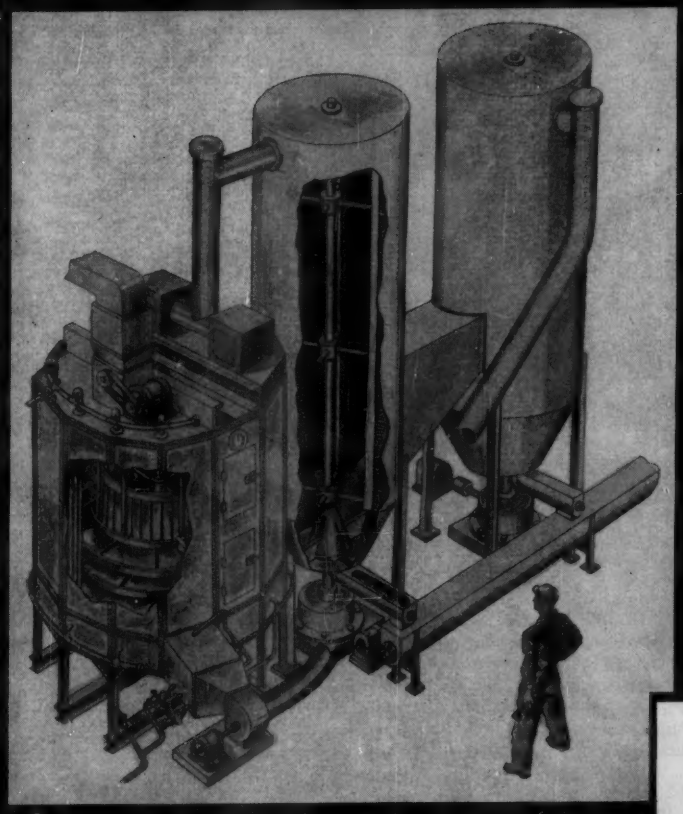
Boilers.....Bulletin VF-VS2, covering Bent Tube Boilers, describes the basic design that provides maximum capacity where floor and head space are limited.
216C Henry Vogt Machine Co.

* From advertisement, this issue

CONTINUOUS SUBLIMATION

with the Wyssmont

TURBO-ENTRAINER SUBLIMER

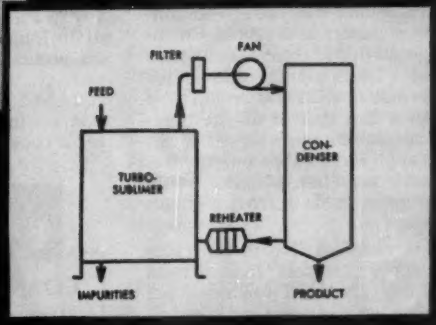


FOR:

★ Subliming from crude solids to produce a pure, crystalline product.

★ Subliming impurities from crude solids.

★ Subliming crude solids and separating the impurity by differential condensation, recovering the crystalline product.



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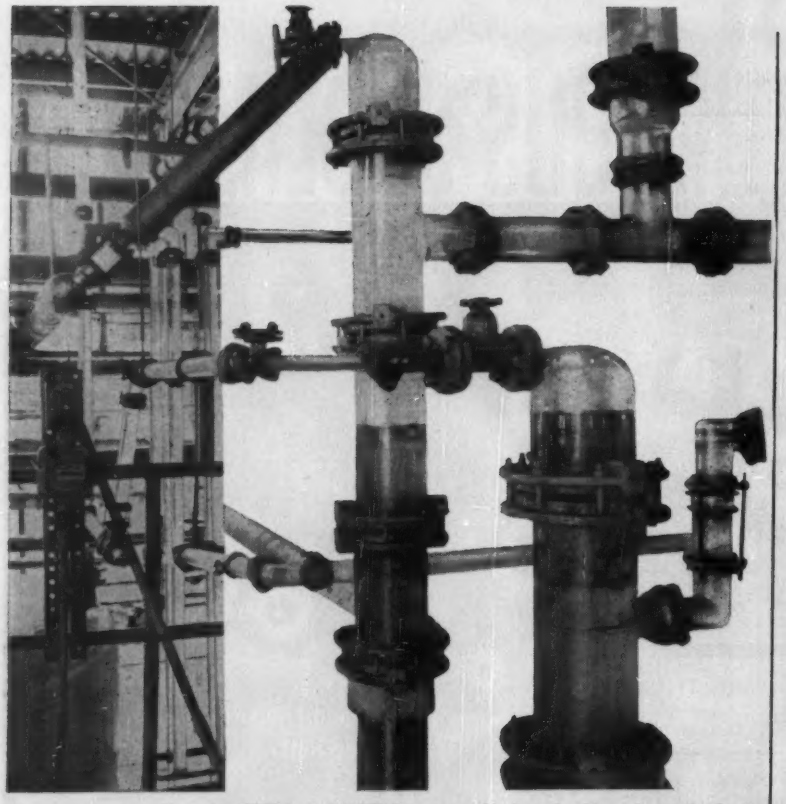

More than 2000 feet of PYREX Pipe carry chlorinated acids and organics for the Velsicol Chemical Corporation. Complicated arrangements such as this can be completed in less than half the time ordinarily taken to install metal piping.

Why even chlorinated compounds do not corrode this pipe

Pump boiling HCl through PYREX brand Pipe *for 200 years* and you'd still find the pipe intact, still trustworthy, still strong, still transparent.

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It's also a fact that of all the thousands of corrosive chemicals you might pump through PYREX Pipe only hydrofluoric acid and hot alkalies would have any appreciable corrosive effects on the pipe.

Blocks side reactions. No metal traces can enter your process from PYREX Pipe and the glass itself can never act as a catalyst, so you never get contaminating side reactions.

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Corning now has an ALL-GLASS PYREX BRAND Y-VALVE. Send for BULLETIN PE-4 Today!

LITERATURE . . .

Dryers, Rotary.....Roto-Louvre dryers provide precise processing for heat-sensitive, friable & hygroscopic materials. Data on this & facts on dryer line in Book 2511.
11 *Link-Belt Co.

Fired Heaters.....Bulletin No. A-46 shows principal design features of standard and special design fired heaters, as required for unusual services.
218A Struthers Wells Corp.

Heat Exchangers.....of titanium and zirconium construction. Fight corrosion in process equipment. Bulletin 949 describes full line of alloy heat exchangers.
246a *The Pfaudler Co.

Heat Exchangers.....Engineered to requirements to provide you with scientifically rated & designed heat exchangers for maximum heat transfer with good operation.
186 *Yuba Consolidated Industries

Heaters.....Bulletin 1411 "Gradiation Heating for Petroleum & Chemical Processing is offered. Also reprint on "Gradiation Heater for Economic Ethylene Production".
112 *Selas Corp. of America

Heat Transfer.....An 8½" x 11" chart for Logarithmic Mean Temperature Difference is available for users or prospective users of heat transfer equipment.
218B Dean Products, Inc.

Heat Transfer Equipment.....Plate-coil units are available in a variety of metals & finishes. Features lower space requirements. Technical Data Manual P61 is offered.
50 *Tranter Mfg. Inc.

Kiln, rotary.....Bulletin 1115 gives whole story of Traylor leadership and experience in rotary kiln design and manufacture. Features oil reservoir and oiling mechanism.
32 *Traylor Engrg. & Mfg.

Refrigeration System.....Steam Jet Vacuum unit for any application requiring chilled water temperatures of from 35 to 65 F. Complete information available.
R227 *C. H. Wheeler Mfg. Co.

Steam Trap.....Gets equipment hot fast & keeps it hot. A complete line for every requirement. Bulletin "The Why and How of Steam Trapping" is offered.
45 *Yarnall-Waring Co.

Thermo-Panels.....take the place of pipe coils. Weighs less & takes less space Facts and complete technical data on all types is available. Send for our copy.
TL243 *Dean Products, Inc.

Instruments & Controls

Analyzer, Gas.....LIRA infra-red analyzers perform vital functions in ammonia synthesis-gas preparation facilities. Bulletin outlines complete system.
111 *Mine Safety Appliances Co.

Comparators.....for fast, accurate pH, Chlorine, phosphates or nitrates test. Handbook, "Modern pH & Chlorine Control", gives theory & application.
L242 *W. A. Taylor & Co.

* From advertisement, this issue

LITERATURE . . .

Computers, Electronic.....LGP-30 is easy to operate, plugs into any regular wall outlet and is completely mobile. Detailed information & specifications offered.
34 *Royal McBee Corp.

Control, Liquid Level.....available for controlling level changes from ⅛" to 150 ft. Multi-stage switching when desired. Detailed information is available.
BL221 *Magnetrol Inc.

Control, Pneumatic.....Model RVA-Recording or model IVA-Indicating type pneumatics can be used in systems regulating the flow of steam, water or gas. Details.
73 *The Partlow Corp.

Controller . . . . . Tri-Scope start up without overpeaking, recover from large load changes without overpeaking & offers superior control following normal load changes.
22-23 *Taylor Instrument Co.

Detector.....Gamma-sensitive scintillation detector designed for medical diagnostic use of redioisotopes. Ideally suited for thyroid or kidney function studies.
37-38h *U.S. Industrial Chem. Co.

Flow Meters.....Two accurate and economical meters for liquids or air, steam and gases are described and illustrated in a new bulletin. Accurate to 2% total flow.
220A Builders-Providence, Inc.

Gauges.....Catalog gives complete data on high pressure gauges, gauge cocks, large chamber reflex gauges & heated or cooled gauges. Send for your copy.
R223 *Strahman Valves, Inc.

Indicators.....Disposable-paper temperature indicators developed for measuring temperatures attained by heat-sensitive biologicals, etc. in storage & transit.
37-38l *U. S. Industrial Chem. Co.

LMTD Nomograph.....Chart for log mean temperature difference is available from heat-transfer equipment manufacturer at no cost. Chart size is 8½ x 11 in.
220B Dean Products, Inc.

Meters, Liquid.....Designs to measure most anything that flows . . . including all stainless steel meters for corrosive liquids. Full details on meters & accessories.
95 *Rockwell Mfg. Co.

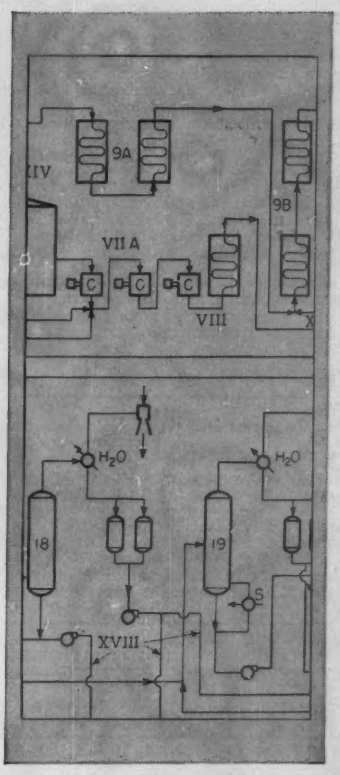
Pneumatic Regulator.....Electrically controlled, the RV-23E regulator operates at different predetermined pressure level sequence. Safety switch permits venting.
220C Marotta Valve Corp.

Pressure Balances.....accurately calibrate pressure gauges. Models are available with pressures ranging to 100,000 p.s.i. Complete information in Catalog 407-C.
187 *Amer. Instrument Co., Inc.

Pyrocon.....Alnor Portable Pyrocons come in scale ranges to 2000 F., with thermocouples for every application. Compact in size. Full details in Bulletin 4257.
L227 *Illinois Testing Laboratories

Ratio Regulator.....The new Type R is a true force-balance controller with only two moving parts. Advance bulletin 582 outlines features & operating principle.
220D The W. A. Kates Co.

* From advertisement, this issue



Large chemical process equipment

designed and built by Dravo's experienced team of engineers and production men, can often mean large dollar savings to your company. Dravo's know-how in custom-built equipment can help you reduce costs through use of large, efficient processing units.

Find out how this service can add dividends to your processing equipment investment. Contact Process Equipment Department, Dravo Corporation, Pittsburgh 25, Pa.

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The operating principle behind MAGNETROL LIQUID LEVEL CONTROL

Because its operating principle, based on the proper use of a permanent magnet, guarantees a perpetual guardianship over your critical liquid levels, the Magnetrol liquid level control unobtrusively takes the most important place in any system or process where it is necessary to keep a liquid at a constant level. Principle and action are so simple that failure is virtually impossible. Magnetrol is versatile, too—will handle almost ANY liquid, at ANY temperature, at ANY pressure, with the same precision and dependability. No mechanical or electrical linkages to stick, bind, ride out of line or wear out. Available for controlling level changes from ⅛" to 150 ft. Multi-stage switching when desired. Write to

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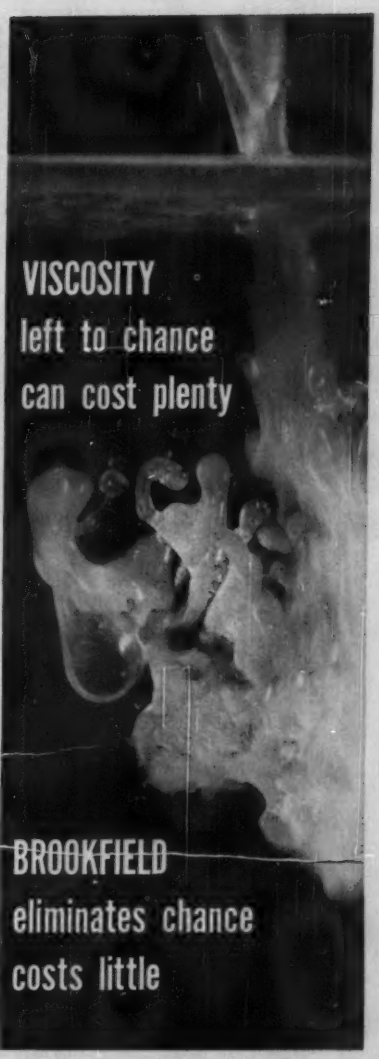

If you, like most chemical processors, are in the rough marketing position whereby you can't tolerate needless production waste . . . then give this some thought.

Have you considered the role of viscosity control in your processes? If not — you should! Viscosity is a product dimension that experience has shown should not be ignored . . . a product dimension Brookfield has proved need not be ignored. Both Brookfield laboratory Synchro-Lectric Viscometers and process-mounted Viscometrans involve small investments: yet they provide easy, accurate measurement, evaluation and control of viscosity in any fluid. Brookfield instrumentation is so simple that no special personnel training is required for operation.

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ENGINEERING LABORATORIES INCORPORATED
STOUGHTON 13, MASSACHUSETTS

LITERATURE . . .

Remote Controls.....Hydra-Trol controls are manual-hydraulic positioning devices, and feature a two-direction positive stroke. System is self-contained.
222A Trimount Instrument Co.

Scales, Industrial.....When you have a problem in weighing, testing, counting, batching, sorting or weight data processing. Information is available.
52 *Toledo Scale Corp.

Thermocouples.....Four basic designs of miniature thermocouples—gasket, bayonet, protected and shielded—are described in a new 28-page catalog.
222B Thermo Electric Co., Inc.

Transmitter, Temperature.....Features stable operation, fast response & high accuracy. Bulletin 13-17 fully explains the type 12A pneumatic temperature transmitter.
43 *The Foxboro Co.

Transmitters.....Two new f/b line models permit new accuracy in measuring flow & differential pressure. Applications for steam, air, gases, water, etc. Information.
114 *Bailey Meter Co.

Viscometers.....Viscosity can represent a fundamental property which will determine a fluid's ultimate composition or quality in use. Information on instruments offered.
R221 *Brookfield Engineering Lab.

Pipe, Fittings Valves

Coupling, Reducing.....supplied in line sizes from ⅜" to 2", they are recommended wherever a complete stainless steel line check valve is required. Bul. CE 118.
198 Durable Manufacturing Co.

Fittings.....The low carbon C-1025 steel insures optimum weldability, & strength. Information about 1025 steel & your commercial forging requirements is offered.
204 *H. K. Porter Co., Inc.

Fittings.....including, elbows, returns, stub ends, tees, reducers, caps, crosses, & 45 laterals. Flanges & special fittings also availalbe. Bulletin 414A.
6 *Flowline Corp.

Fittings & Flanges.....now with individual packaging in rugged containers to protect against damage. Each container marked with size, type material & production lot.
Cover *Tube Turns, Div. of Chemet

Flange.....Speedline insert flanges provide leakproof joints. The complete line of Speedline corrosion fittings is outlined in Catalog. Send for your copy.
91 *Horace T. Potts Co.

Gaskets.....made with a variety of filler constructions to suit every connection problem & every pipe & nozzle material requirement. Catalog AD-154.
190a *United States Gasket Co.

Joints, Expansion.....made from a variety of stainless & high alloys . . . for service from 320F to 1200F Sizes range from ½" to 35 ft. in diameter. New catalog offered.
58 *Solar Aircraft Co.

* From advertisement, this issue

LITERATURE . . .

Joints, Expansion.....made of chemically impervious Teflon. They correct misalignment, connect unlike piping ends & nozzles. Details in Catalog No. AD-137.
190b *United States Gasket Co.

Nozzles, Spray.....to control liquid particle size & field distribution with accuracy. Offered in a wide range of types & capacities. Complete information in catalog 24.
TL219 *Spraying Systems Co.

Packings, Braded.....There are 15 individual field-proved types available for temperatures from 120 F to +600 F. High or low shaft speeds. Bulletin P-325.
200 *Crane Packing Co.

Pipe, Pyrex.....Bulletin PE-3 tells you something of the long history of this pipe in chemical processing, lists sizes & fittings, & offers information on installation.
218a *Corning Glass Works

Seals, Mechanical.....are now available for almost every make, model & size centrifugal pump . . . & for other rotating shaft sealing applications. New bulletin offered.
71 *Borg-Warner Mechanical Seals

Valves.....Steel flexible gate valves for use in power & process piping. Holds tight at both seat faces; upstream & downstream. Information on pressure classes & sizes.
141 *Crane Co.

Valves.....for handling water, oil, gas, air, steam & corrosive fluids. Available in the most required sizes & types. Complete information on request.
83 *The Wm. Powell Co.

Valves.....Multiport for 3-way & 4-way flow control with one valve. Complete line of lubricated plug valves, both Multiport & Straightway. Details available.
113 *Rockwell Mfg. Co.

Valves, Ball.....feature two sealing surfaces & handle wide range of liquids & gases. They are easily adapted for remote control devices. Literature available.
193 *Jamesbury Corp.

Valves, Check.....available in ¼" thru 2" sizes in both screw & socket weld ends. Forged steel bodies are designed for light weight with maximum strength.
167 *Henry Vogt Machine Co.

Valve, Control.....available in globe or angle body single port construction. For use on heavy duty applications involving corrosive liquids. Bulletin 57B.
119 *Fisher Governor Co.

Valves, Gate.....In a wide range of corrosive & erosive services these valves withstand corrosion. Information folder No. 205 gives details on Ni-Resist valves.
109 *Jenkins Bros.

Valves, Iron.....Feature yokes in all sizes, T-head stem-wedge connection, and threaded backseat bushing. Complete specification literature is available.
18-19 *The Ohio Injector Co.

Valves, Knife Gate.....available in a wide range of metal combinations & in several different styles. Handle corrosive chemicals. Details in Bulletin 300.
44 *DeZurik Corporation

* From advertisement, this issue

LITERATURE . . .

Process Equipment

Agitators, Tank Top.....Model WT is available in 7 sizes with a complete range of speeds. Feature helical gear trains & worm gears. Bulletin 551 and data sheet.
214 *New England Tank & Tower Co.

Centrifugals.....A catalog is offered on the time-saving Batch-Master centrifugal. Rapid bottom discharge & hydraulic unloading save processing cycle time.
241 *Amer. Machine & Metals, Inc.

Dissolvers.....for ultimate dispersion, dissolving, emulsifying & deagglomerating in processing solid-liquid, liquid-liquid & gas-liquid materials. Information in catalog.
115 *Morehouse-Cowles

Drying Systems, Flash.....for production of fine dry powered materials by automatic dust-free operation. Shortens the process time. Details for requirements.
142 *Combustion Engineering, Inc.

Dust Collectors.....Cyclones feature large-diameter design that eliminates bridging & clogging. Booklet, "The Exclusive Buell Cyclone" for complete information.
226 *Buell Engineering Co.

Feeders, Airlock . . . . . available in standard duty, heavy duty, & blow-thru types. Booklet P-58, "How to Select A Rotary Airlock Feeder", is offered.
BL219 *Prater Pulverizer Co.

Filter Cloth.....NFM CR treated filter cloth is one of the many types of cloth available. Synthetic fibers such as; Glass, Nylon, Dacron, etc. also available. Test Samples.
216 *The Nat'l. Filter Media Corp.

Filter Media, Metal.....can withstand temperatures from 420° to 1200° F. & pressures from a nearly perfect vacuum to 6,000 psi. Brochures outline what they can do.
211 *Purolator Products, Inc.

Filter Press.....available in a design & capacity to handle any filterable mixture & any filter material. Catalog contains erection, operating, & construction data.
192 *D. R. Sperry & Co.

Filters.....No separate scavenging operation with this filter . . . downtime reduced & no liquid heel left at end of filtration cycle. Information available.
240 *Amer. Mach. & Metals, Inc.

Filters.....For service throughout the chemical & petrochemical industries. Available in standard & specially engineered units with wide range of accessories. Bulletins.
124a *Process Filters, Inc.

Filters, Dust.....The new bag has 3 equal size sections. Each pocket has two spacers, making a total of six per bag. Other details in Bul. 105 & Dust Control Catalog.
228 The W. W. Sly Mfg. Co. Corp.

Filters, Rotary Vacuum.....Bulletin No. KSI-2 gives detailed information for the process industries. Also recommendations for Pilot Plant equipment.
183 *Komline-Sanderson Engr.

* From advertisement, this issue

LITERATURE . . .

Filtration Equipment.....To improve product quality and cut processing costs. Specialized engineering service is available to you. Descriptive literature available.
20-21 *Industrial Filter & Pump

Floats.....Complete technical data is available in Harris Floats catalog. Experienced engineers will help you select the right type for your installation.
BL 243 *Arthur Harris & Company.

Grinding Plant.....Plant components are designed, applied & "coordineered" to handle materials in a 30 to 300 lb per cu. ft. range. Complete details are available.
135 *Allis-Chalmers

Impactor.....for secondary grinding. Reduces limestone & material of similar hardness to 1½, ¾, inch or smaller. A size for every job.
185 *Williams Patent Crusher & Pulverizer Co.

Micronizer.....grind and classify in one operation in a single chamber. Can handle heat-sensitive materials. Eight models available . . . for full description Bul. 091.
R219 *Sturtevant Mills Co.

Mill.....The Tornado Millis a unit for granulating, pulverizing, mixing, pulping or chopping materials of all types, including wet or sticky products. Specifications offered.
224 *F. J. Stokes Corp.

Mixer, Grease.....Mixing principle combines a high-speed radial propeller which gives excellent mixing & shearing of the grease plus the pumping action of a turbine.
195 *Struthers Wells Corp.

Mixers.....Important design advantages include, extra large, heavy duty bearings throughout & extra long out-ut shaft bearing span. Cat. A-27.
30-31 *Philadelphia Gear Corp.

Mixers . . . . . Continuous double arm mixers turn out ½ to 3 cubic feet per minute . . . in a completely homogeneous mix. Feature temperature controlling jackets.
53 *Read Standard

Ovens, Laboratory & Drying.....Any type of drying oven ready-made or custom engineered to your exact specifications. Full information available.
62 *Despatch Oven Co.

Process Equipment.....Roto-Vak provides high density heat transfer and helps upgrade product quality. Handles any fluid material. Details in new Bulletin 383.
24-25 *Blaw-Knox Co.

Pulverizer & Classifier.....The Pulvocron . . . an air attrition impact with controlled radial inward classification in one operation. Color bulletin is offered.
89 *The Strong-Scott Mfg. Co.

Sublimer.....The Turbo-Entrainer for subliming from crude solids to produce a pure, crystalline product, subliming impurities from crude solids, etc. Information.
217 *Wyssmont Company, Inc.

Vapor Condenser.....Bulletin 139R describes the Aero Vapor condenser, illustrated. Capacity curves are provided for eight sizes; tables of dimensions.
Niagara Blower Co.

* From advertisement, this issue

LITERATURE . . .

Pumps, Blowers, Compressors

Air-Cooling.....Solo-aire or Combin-aire units cool with maximum air & minimum water. For use in oil, gas & chemical processing plants. Equipment bulletin offered.
35 *Hudson Engineering Corp.

Compressor, Spiraxial.....Units are sized for direct-connected drives with motors, engines or turbines, at speeds from 1,750 to 3,550 RPM. Requires no water jacketing.
121 *Roots-Connersville Blower

Compressors.....Bulletins available on reciprocating or centrifugal process compressors. Available from 200 to 6000 horsepower for all gas processing.
100 *Cooper Bessemer

Compressors.....All wearing parts are field replaceable. Range from 1.93 to 6048 CFM with wide choice of Prime movers & drives. Details in Bulletin 242-11.
7 *Joy Manufacturing Co.

Fans ..... Resin-bonded fiber glass fume fans are corrosion-resistant, impact-resistant & won't support combustion. Details including chem. resistance tables, Bul. FI-511.
50 *Buffalo Forge Co.

Pump.....Moynos can pump any chemical, whether a thin watery slurry or an extremely viscous material. Discharge is uniform, non-pulsating. Bulletin 30-CE.
57 *Robbins & Myers, Inc.,

Pump, Chemical ..... Pulsafeeder is a combination piston-diaphragm pump. Bul. 440 gives typical applications, flow charts, descriptions & specifications of models.
51 *Lapp Insulator Co., Inc.

Pump, Triplex.....is a rugged heavy-duty machine built to minimize operating inspection & maintenance costs. Pressure ranges from 500 to 2000 psi. Bulletin.
54 *Manton-Gaulin Mfg. Co.

Pump or Meter.....Small capacity designed to fit conventional laboratory stirring motor drives is now on the market. Handles small flows of slurries, pastes, etc.
37-38m *U. S. Industrial Chem. Co.

Pumps.....decreased down-time to a minimum . . . maintenance costs reduced substantially. Full information available as to installation & maintenance.
128 *Aldrich Pump Co.

Pumps, Acid.....for capacities to 3000 GPM. Available with pumping parts of the machinable alloys as well as plastic for all requirements. Complete information offered.
105 *A. R. Wilfley & Sons, Inc.

Pumps, Glass.....for highly corrosive liquids. Handle temperatures up to 350 F. on all acids except hydrofluoric. Full details in Bulletin 727.3. Send for your copy.
242b *Goulds Pumps, Inc.

Pumps, Vertical Process.....for handling highly volatile, inflammable, toxic, explosive or other dangerous liquids. Bulletin No. 727.2 gives complete details.
242a *Goulds Pumps, Inc.

* From advertisement, this issue

LITERATURE . . .

Services, Processes, Misc.

Analytical Methods . . . . . Paper describes an improved method of determining acids and basic nitrogen compounds in petroleum products. It's simpler, faster.
232A L. Sonneborn Sons, Inc.

Equipment, Iron.....Catalog A-9 presents a complete engineering picture, descriptions, specifications, and data on blinds, spacer rings, strainers & flanges.
TL225 *The Mack Iron Works

Extinguisher, Fire.....The pressurized 200-lb. extinguisher offers a low, balanced center of gravity, wider handle, compact design & lubricated wheels. Complete details.
222 *Walter Kidde & Co.

Fabrication.....Reboiler made of all carbon steel . . . one of the many products designed & fabricated. Design practical trouble-free equipment to all codes.
184 *Manning & Lewis Co.

Fabrication . . . . . Booklet, "Facilities and Products" outlines the types of pressure vessels & other heavy process equipment fabricated by this company.
122 *Newport News Shipbuilding

Laboratory Equipment.....62 p. catalog supplement 58 lists scientific instruments and apparatus introduced since the publication of Catalog 100.
232B E. H. Sargent & Co.

Laboratory Equipment.....2 p. sheet describes various heating, treating, processing, production and laboratory furnaces and two series of forces convection ovens.
232C L & L Mfg. Co.

Molecular Models.....Full color folder describes new polyvinyl chloride models with which you can construct all organic forms which can exist. Kit contains 100 atoms.
232D Will Corp.

Particle accelerators.....A 12-page booklet describes the many known and potential applications of Van de Graaff and linear accelerators. Utilizes photos and line drawings.
232E High Voltage Engineering

Quality Control.....20 p. book, "Quality Control—A Company's Conscience at Work," describes rigorous tests for company's Tenite plastics.
232F Eastman Chemical Products

Research . . . . . Fully equipped for studies & tests in crushing, grinding, classifying, screening, etc. Bul. D-1005 fully describes this complete
L229 *Kennedy Van Saun Mfg. & Engr.

Welding.....Methods and specific information are outlined in the illustrated Weldment Bulletin 7001. The welding of pressure vessels is one of the many jobs detailed.
118 *Baldwin-Lima-Hamilton

Wrenches . . . . . Extra heavy-duty Loxocket design holds wrench & socket head together safely. Set includes 11 double-hex sockets & 6 Single-hex sockets.
220 *Snap-On Tools Corp.

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METALLURGISTS (B.S., M.S. or Ph.D.) Physical and mechanical applications.

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Manufacturer of Heat Exchangers and Pressure Vessels, located in New Jersey, wants sales representatives in various parts of country. Representatives should have contacts in oil refineries, power plants, chemical plants or marine. RW-8806, Chemical Engineering.

Manufacturers' representatives desired for a complete line of solid adsorbent instrument air dryers and compressed gas dehydrators in all territories east of the Mississippi River. Representatives should be selling instrumentation and equipment to oil refineries, chemical plants, and power plants. Gas Drying Inc., Box 56, Summit, N. J.

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EQUIPMENT SEARCHLIGHT

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DONORA ZINC WORKS — **DONORA, PA.**

1—Traylor 10' x 120' Rotary Kiln, ¾" shell.
2—Ruggles Cole 90" x 55' Class A14 Rotary Dryers, 7/16" shell.
2—Herreshoff 20' dia., 16 hearth, Furnaces.
1—Buflovak 550 sq. ft. Monel Single Effect Evaporator.
2—Swenson 6'6" dia. x 5' deep, steel, jacketed Vacuum Pans.
1—Blaw-Knox 1400 gal. steel, jacketed, agitated Vacuum Kettle.
1—10,000 gal. Horizontal Steel Pressure Tank, 200# pressure.
10—Lead lined, agitated Tanks, 1000 to 6500 gallons.
Troughing Belt Conveyors; Bucket Elevators; Bins, 50 to 500 tons; Ball Mills; Jaw Crushers; Roll Crushers; Air Compressors.

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1—4000 gal. 347 S.S. jacketed Reactor, 150# internal.
1—Blaw-Knox 500 gal. 304 clad, jacketed, agitated Reactor.
2—Pfaudler 1500 gal. glass lined, jacketed, agitated Reactors, 90# jacket.
1—750 gal. nickel clad Mixing Tank, 125# internal, with nickel coils.
2—Patterson 1000 gal., steel, jacketed, agitated Reactors, 20 HP.
1—Vulcan Briquetting Press, 30" dia. x 12½" face, 304 S.S. rolls, 50 HP.
1—3500 gal., 304 S.S. jacketed, agitated Tank, 9' x 7'.
1—Haveg 4000 gal. closed Storage Tank.
2—5000 gal. 304 S.S. Horizontal Tanks, 6'6" x 20'. Unused.
4—Stainless Heat Exchangers, 1220, 1080, 786, 500 sq. ft.
1—Sharples C20 Super-D-Hydrator, 316 S.S., vapor tight XP Timers.
2—Sharples PN14 & PY14 Super-D-Canters, 316 S.S.
1—Sharples CH2 Nozzlejector, 15 HP.
4—Bird 18" x 28", 24" x 38", 316 S.S. continuous Centrifuges.
3—American 42" x 120" Double Drum Dryers, 10 HP motors.
1—Buflovak 48" x 40" nickel, single drum Flaker.
1—Bird 40" suspended Centrifugal, 347 S.S. perforated basket.
2—Buflovak 250 & 20 sq. ft., 304 S.S. forced circulation Evaporators.
2—Feinc 5' x 6' stainless steel Rotary Vacuum Filters.
2—Sparkler 33-S-28 Pressure Filters, 150 sq. ft., 304 S.S.
1—Niagara 36 H-110 horizontal 304 S.S. Filter, 110 sq. ft.
1—Baker Perkins #16 TRM, 150 gal., jacketed sigma blades, Vacuum Mixer.
1—Baker Perkins #15 VUMM, 100 gal. jacketed Mixer, 100 HP motor.
3—Stokes R, single punch Tablet Machines, Unused.

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1—Unused 4,500 gal. Vert.
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6—465 gal. reactors, T304 ELC SS, 150# int. 160# jkt.
1—450 gal. reactor T347 SS, 15# jkt. agit.
1—100 gal. T304 SS reactor, ASME Vac. int. 75# jkt. UNUSED.
1—Pfaudler 1000 gal. G.L. reactor, ASME 75# jkt., 25# int.
1—Pfaudler 600 gal. G/L reactor, jkt., agit.
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1—Pfaudler 300 gal. G/L reactor, ASME Vac. int., 75#.
1—Pfaudler 100 gal. G/L reactor, ASME Vac. int., 75# jkt.
1—Pfaudler 30 gal. G/L reactor, 25# int., 75# jkt. Agit.
5—1800 gal. Steel Kettles, 180# jkt., paddle agit.
1—1500 gal. Steel reactor, ASME 600# int., 150# jkt.

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1—Buflovak evaporator, 588 sq. ft., double effect, vert. long tube, T304 SS.
2—Nickel clad evaporators, 400 & 250 sq. ft. vert. long tube.
1—Stokes evaporator, 236 sq. ft., double effect, T316 SS.
2—Buflovak evaporators, 250, 20 sq. ft., forced circulation, T304 SS.
1—Struthers-Wells evaporators, 625 sq. ft., T347 SS, full vacuum.
3—Sanitary Vacuum Pans, 6' dia. SS, internal coils.
1—B & S evaporating kettle, 600 gal. SS, 6' dia. agit.

PRESSURE LEAF FILTERS

1—Niagara #510-28, 510 sq. ft. vertical, T316 SS.
2—Sparkler #33-S-28, 150 sq. ft., T304 SS leaves, (1) with T304 SS tank, (1) with steel tank.
1—Niagara #36H-110, 110 sq. ft., horiz. T304 SS.
1—Niagara #80-30, 80 sq. ft., vertical, T304 SS jacketed.
1—Niagara #45-30, 45 sq. ft., vertical, T304 SS leaves, steel tank.
1—Alsop SD-12-WR-30 St. St. filter.

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5' x 10' rod, Kennedy-Van Saun
8' x 10' pebble, batch, Patterson
6' x 8' pebble, contin., Patterson
6' x 8' pebble, batch, Patterson
6' x 5' pebble, batch, H. K. Porter
6' x 4'6" ball, Marcy #64½, 125 HP
5' x 6' pebble, batch, Abbe
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1—A.T. & M., 48" Susp., T304 SS perf. basket, vapor tite, 25 HP
1—Bird 40" Susp., steel imperf. basket
1—Fletcher 40" Susp., SS perf. basket
1—Fletcher 30" SS perf. basket
1—Tolhurst 36" centerslung bronze
1—Fletcher 12" Underdriven T304 SS imperf. basket

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5—Copper bubble cap columns; 24" dia. x 11 plate; (2) 42" dia. x 20 plate; 42" dia. x 40 plate; 48" dia. x 20 plate.
4—Copper Tunnel cap columns; 24" dia. x 30 plate; 36" dia. x 27 plate; 36" dia. x 39 plate; 36" dia. x 59 plate.
3—Stainless Steel packed columns; 8" dia. x 26', T347; 14" dia. x 25' T304; 24" dia. x 27', T304.

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24—Baker-Perkins #17, 200 gal. sigma blade, jkt'd.
2—Baker-Perkins #K-300 "Ko-Kneaders", 150# jkt., 60 HP.
1—Baker-Perkins #15-USE, 100 gal., 75 HP, Dispersion blade, Stainless Steel, jkt'd.
1—Baker-Perkins #15 JNM, 100 gal., sigma blades, jkt'd., 30 HP.
1—Baker-Perkins #15 VUMN, 100 gal., 100HP, Dispersion blade, steel, vacuum cover, jkt'd.
1—Baker-Perkins #15 JYUE, 100 gal., jkt'd., 20 HP
1—Baker-Perkins #14 JIM, 50 gal., 50 HP naben blades, jkt'd.
2—J. H. Day 35 gal., sigma blade.
1—Day 5 gal., sigma blade, T304 SS.

MIXERS, POWDER

1—Stainless Steel 425 cu. ft. ribbon type.
2—Jacketed paddle mixers, 250 cu. ft.
1—Sprout-Waldron 200 cu ft., ribbon
1—Worthington 70 cu. ft. rotary dry batch blender, 30 H.P.
1—Industrial 75 cu. ft. ribbon type mixer.
1—Robinson 15 cu. ft. St. St. ribbon jkt'd.
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CENTRIFUGES:

1—32" suspended type centrifuge with imperforate basket
3—Tolhurst center slung centrifuges, 40" and 48" with rubber covered perforated basket
1—Baker Perkins type 316 SS Ter Meer Centrifuge, Model HS-24"
1—Sharples #16P pressurite SS super centrifuge
1—AT&M type 316 SS suspended type centrifuge with 26" perforated basket

DRYERS:

3—Link Belt steel roto louver dryers, Model 207-10, 310-16, 310-20
1—Buflovak double drum dryer, 42" x 120"
1—Louisville rotary steam tube dryer, 8' x 45'
1—Louisville SS rotary kiln, 30" x 28', complete
1—Buflovak double drum dryer, 42" x 90"
2—Stokes SS rotary vacuum dryers, 2' x 6' and 3' x 15'
1—Stokes rotary vacuum dryer, 5' x 30'
6—Stokes rotary vacuum dryers, 3' x 15'

FILTERS:

1—Oliver horizontal filter, 6'6"
1—Feinc SS rotary string filter, 3' x 3' (NEW)
1—Oliver horizontal 3' pilot plant filter (NEW)
1—Sweetland #7 filter with 20 steel leaves
10—Sweetland filters, #12, with 72 SS leaves

AUTOCLAVES, KETTLES & TANKS:

1—Glascote glass lined jacketed kettle, 500 gal.
1—Theo. Walters 500 gal. SS jacketed reactor
1—Nickel jacketed 1000 gal. kettle
1—Combustion Eng. 1600 gal. jacketed autoclave, 600# working pressure internal, 125# jacket
1—Aluminum horizontal storage tank with dished heads, 12,000 gal.
1—Pfaudler glass lined jacketed kettle, Series P. 20 gal.

MIXERS:

3—Robinson type 316 SS sigma type jacketed heavy duty mixers, 300 gal. 60 HP.
3—Howes 40 cu. ft. rubber covered ribbon blenders
1—Leader SS jacketed 51 cu. ft. ribbon blender
5—Baker Perkins sigma blade jacketed 100 gal. mixers.
3—Howe 1000# rubber covered ribbon blenders (NEW)
1—Leader SS jacketed 51 cu. ft. ribbon blender

MISCELLANEOUS:

2—Heat Transfer Products steel bubble cap column, 36" and 42" with 5 and 10 trays
1—Acme steel bubble cap column 42" dia. with 10 trays
1—Downington Iron steel bubble cap column 24" dia. with 14 trays
1—Badger type 316 SS bubble cap column 36" dia. with 8 trays
1—Badger type 316 SS bubble cap column 42" dia. with 11 trays
2—Patterson Kelley, steel heat exchangers, 1000 sq. ft. each
2—Badger type 316 SS heat exchangers, 400 and 480 sq. ft.
2—Belle & Grossett heat exchangers, steel, 73 sq. ft. each
6—Struthers Wells heat exchangers, 885 sq. ft.
1—Patterson Kelley steelheat exchanger, 427 sq. ft.
50—Steel heat exchangers from 15 sq. ft. to 400 sq. ft.
4—Type 317 SS heat exchangers, 892 sq. ft. each, 200 PSI
30—Struthers Wells SS heat exchangers 650 sq. ft. each
1—Struthers Wells SS heat exchangers, type 316, 330 sq. ft.
2—Stokes tablet presses, Model T
1—Bolling 8" x 16" 3 roll laboratory calender

1—Sweetland #3 SS filter, 70 sq. ft.

1—Niagara SS filter, Model 510-28

2—Swenson type 316 SS vacuum crystallizers, 3'6" x 12' and 2'6" x 12'

1—AT&M 18" suspended type stainless steel centrifuge, complete

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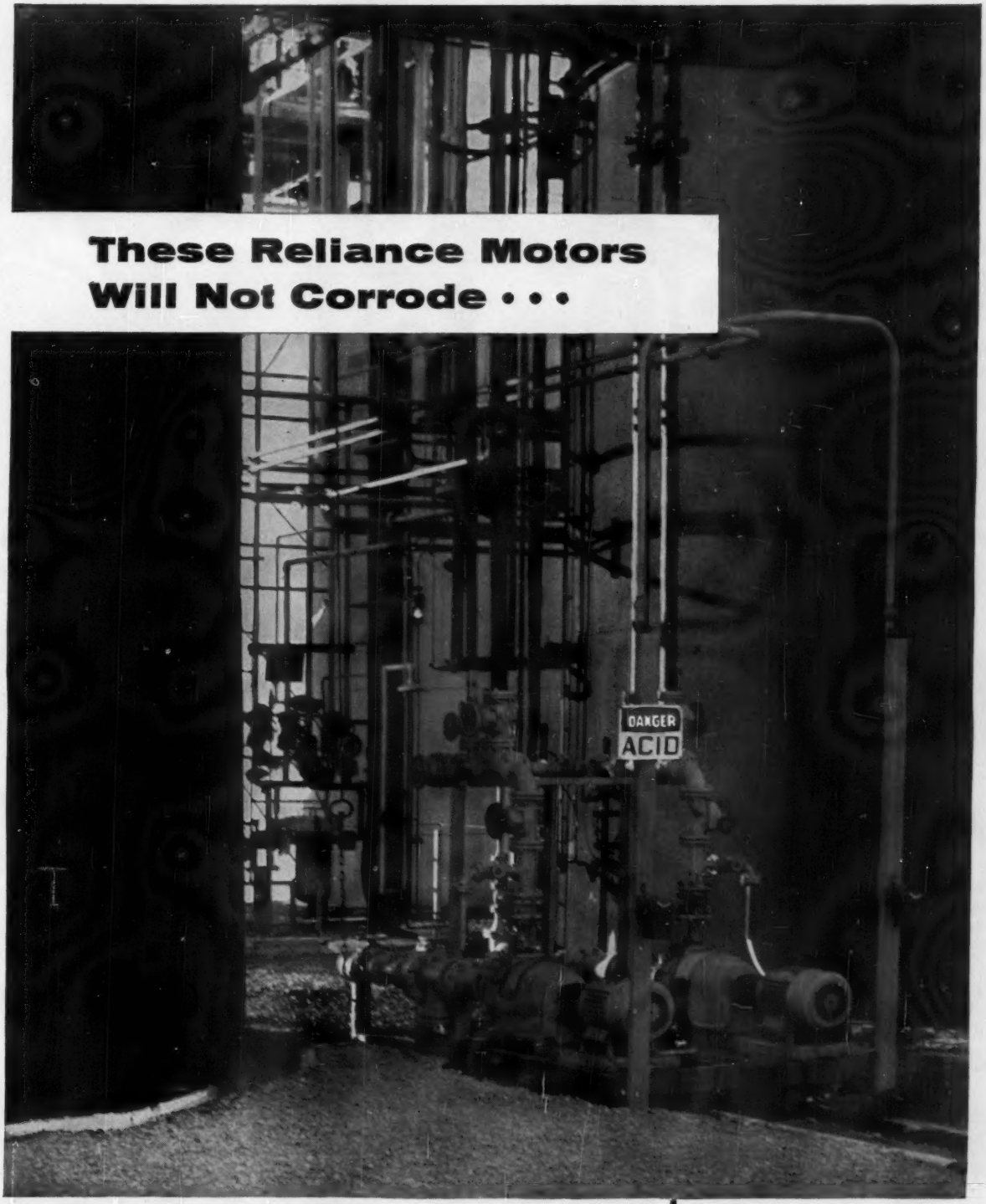

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